

A Taxonomic Revision of the Hawaiian Species of the Genus *Carex*¹

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INTRODUCTION

LINNAEUS PUBLISHED the genus *Carex* in *Genera Plantarum*, Ed. 1, p. 280, 1737, and again in *Genera Plantarum*, Ed. 5, p. 420, 1754. The present use of the name is based on the latter. The type species for the genus has been designated by Mackenzie (1923: 343) as *Carex acuta* var. *nigra* L., which has been known erroneously for some time as *Carex Goodenowii* J. Gay. Hitchcock and Green, however, have listed *Carex hirta* L. in their list of Linnaean lectotypes (Camp, 1947: 114). The problem of typification is still an open one. The genus was recognized as a natural group even before the time of Linnaeus, but from 1754 to 1915 the group was included in different genera in accordance with various generic concepts, and also attempts were made to split the genus into segregates. Since 1754 a total of 55 generic names has been proposed for the genus or its segregates. Nevertheless, it is the consensus of present-day workers that the group, though large, deserves the unity of single generic rank.

In the Hawaiian Islands specimens of *Carex* have been regularly collected by botanists visiting the islands. The earliest collection examined for this study is that of James Macrae, which was secured on the island of Hawaii during the visit of H.M.S. "Blonde" in 1825. Since that date collections have been deposited in all the major herbaria in the world. In spite of the splendid collec-

tions which are available (approximately 600 numbers were received for this study), no monographic study of the Hawaiian carices has been made. From time to time species and varieties have been described from these islands, but often by botanists working far from Hawaii and who were using not only single specimens but often mere fragments of a plant.

Taxonomic differentiation within the genus rests fundamentally on the morphological differences in the achene and surrounding perigynium. The wide and distinct variation of these structures in such a vast number of species is remarkable. Identification of the species could be effected by reference to these structures alone. However, generic groupings which included species with similar perigynia but based on other characters—primarily on the arrangement of spikes and inflorescences—have been made. The use of such characters is indispensable in breaking the genus into smaller groups but the characters show much intergradation, and their use results in the placing together of seemingly unrelated species so that doubt is cast on their being natural groupings.

In applying the characters needed to delineate the Hawaiian species, certain considerations involving the nature of species and criteria for their erection or retention in the generic population represented in the islands must be discussed. The genus *Carex*, like many other genera, has been subjected both to extreme division into species and to conservative grouping in large polymorphic or perhaps aggregate species. An investigation to determine which treatment is nearer the truth is not the purpose of this study. The recent development of experimental methods

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in taxonomy is adding much valuable information to the field. No worker can afford to ignore this work. However, taxonomy has not yet reached a stage where these methods can be applied to all new populations coming into the ken of the scientist, though surely all added experimental work, both in genetics and ecology, will aid the taxonomist in interpreting the morphological differences he finds.

To evaluate a population and make it intelligible to other workers, a summary of definitions of the specific and subspecific categories is in order. The following definitions merely indicate the difficulty of determining the genotype of a specimen or population from the phenotype with which the taxonomist works.

Biotypes are relatively slight morphological variations within a constant genotype which vary at random and which reflect no differences in the genetic constitution of the plant. Almost every individual could be classed as a biotype.

Forms are groups of biotypes distinct from the other biotypes of similar genetic structure by one or more very slight morphological characters which are either determined or probable responses to a peculiar environment and may or may not indicate minor genetic differences.

Varieties are groups of biotypes or forms morphologically distinct from the normal biotypic range of the population, these variations being brought about by slight genetic differences and often subsequent isolation. Varieties in a population may interbreed on contact and show a degree of intergradation in morphological characters in some of the individuals.

Species are populations of one or more varieties, forms, and biotypes which are clearly distinct morphologically from all other related populations as a result of major genic differences. Interbreeding is usually restricted or impossible between related species though

certainly radical genetic morphological differences may occur in isolated species without loss of the ability to interbreed.

It is in no way intended to suggest that the above criteria are precise. In applying them to the populations of Hawaiian *Carex* it soon became apparent that both the biotypic and formal variation were much greater than has normally been allowed for species of this genus. In the case of *Carex wabuensis*, particularly, a tabulation technique was used giving all the possible visible or measurable characters by which species could be differentiated. Twenty of the most reliable characters used to differentiate *Carex* species were recorded for each of the specimens examined. The tabulation showed clearly that, in what at first appeared to be several distinct species, the gradations between supposedly distinct characters were so complete as to make impossible a delineation of more than one species. Only two minor characters in the perigynia (and these showing transitions with the typical) were found to be strong enough to be interpreted as of varietal worth. It is probable that even an able taxonomist confronted with a restricted number of specimens would have named several new species from among this group of specimens.

Examination of the work of Mackenzie on the North American carices has made very clear the seriousness of dividing into species populations which are little more than biotypes. An effort has been made here to be somewhat conservative in the erection and retention of species. In defense of this approach it may be said that the evidence strongly suggests extreme polymorphism in many of the groups. Though the species growing in the Hawaiian Islands may be distinct, the world population has other species of very close affinities to almost every one of them. These affinities are indicated in the discussion following each description. Not only does the very size of the genus suggest an extremely unstable and rapidly ramifying

genic structure, but the variations encountered in every species examined (see illustrations) have been considerable—not only in different individuals but in different sections of the inflorescence of the same individual. An effort has been made to keep intact the groups which form natural units, even though there is considerable variation within them.

Acknowledgments: Appreciation is due Dr. Harold St. John, Chairman of the Department of Botany, University of Hawaii, for guidance during the investigation. Miss Inger Achten is responsible for most of the illustrations, which add much to the usefulness of the work. I also wish to thank the directors of the various herbaria who lent material for the study. The cooperating institutions are listed under the Taxonomic Treatment. The effectiveness of the study is to a great degree the result of the work of many collectors.

DISTRIBUTION PATTERNS

The distribution of the genus is world-wide and the range of many species includes several continents. Not only have a vast number of species evolved in the genus but these species have become adapted to a very wide range in habitat as well. The majority are found in areas of more than average moisture but many survive in regions with sufficient rainfall to support grassland vegetation only. Certain of the Hawaiian carices do well in both wet forest and dry grassland, i.e., *Carex macloviana* D'Urv. and *Carex wahuensis* var. *rubiginosa* R. Krauss. Others in the islands are restricted to limited habitats; *Carex montis-eeka* Hillebd. and *Carex kauaiensis* R. Krauss are strictly high-bog plants.

Local distribution of the species and varieties is illustrated in the maps. The discussion following the species description gives the probable affinity and region of origin for each. In as many cases as possible the plants were compared with specimens collected in

the type locality in other parts of the world. The following tabulation indicates the geographic affinities of the Hawaiian species.

Japan and East Asia

- Carex Meyenii* Nees—Hawaiian endemic
Carex wahuensis var. *Meyeri* Franch. and Sav. (the type variety)—Hawaiian endemic
Carex wahuensis var. *rubiginosa** R. Krauss—variety, Hawaiian endemic

Australia

- Carex Nealae* R. Krauss—Hawaiian endemic

Pacific North America

- Carex macloviana* var. *subfusca* (W. Boott) Kükenth.
Carex pluvia R. Krauss—Hawaiian endemic
Carex pluvia var. *koolauensis** R. Krauss—Hawaiian endemic
*Carex alligata** F. Boott—Hawaiian endemic
Carex alligata var. *Degeneri** R. Krauss—Hawaiian endemic
*Carex kauaiensis** R. Krauss—Hawaiian endemic
Carex Svenonis Skottsbo.

Worldwide

- Carex montis-eeka* Hillebd.—Hawaiian endemic

*These species and varieties are presumed to have originated in the islands from the ancestral stock of the species immediately above them.

Apparently original introductions of species to the Hawaiian Islands have come from all of the major land masses bordering the Pacific. Species found in the nearest archipelagos, however, are missing in Hawaii. Others from more distant land masses are well established here. The random origin from east, west, and south, and the limited number of species present, indicate infrequent establishment over long periods of time. It is the studied opinion of the author

that winds of hurricane force sweeping across the Pacific in different directions at different periods of geologic time are responsible for this random deposition. Certainly tremendous variations in climate have existed since the origin of the islands sometime in the early Tertiary period.

Speciation and distribution of the carices of Hawaii have not followed the usual pattern found in many island genera. There are only two narrow endemics—*Carex kauaiensis* R. Krauss, which is limited to the bogs of Kauai, and *Carex pluvia* var. *koolauensis* R. Krauss, which is found in the central Koolau Range on Oahu. The other species occur on most of the islands, though certain ones are conspicuously missing on the more westerly islands. There are no records of *Carex macloviana* var. *subfusca* (W. Boott) Kükenth., *Carex Svenonis* Skotts., or *Carex Nealae* R. Krauss on Oahu, Molokai, and Kauai. Hawaii and Maui, on the other hand, have every species and variety with the exception of *Carex kauaiensis* R. Krauss and *Carex pluvia* var. *koolauensis* R. Krauss. *Carex Meyenii* Nees, however, is the only species found on all the islands. The lack of local endemism is to be expected in a genus which fruits prolifically and is dispersed easily by air and water. Most of the species and varieties are able to survive on ridges as well as in ravines, so that geographical isolation of minor mutations does not occur often enough to be a factor in the development of taxonomic entities. Nevertheless, there appears to be some difficulty in achieving dispersal across the channels of water separating the islands. It is to be expected that a complete distribution will be achieved naturally in the future inasmuch as suitable habitats exist on all the islands for almost all of the species. The range of *Carex wahuensis* var. *rubiginosa* R. Krauss, which is moving into the region occupied by variety *Meyeri*, by migration from east to west, illustrates the path of such invasions although

the habitat range for this species is considerably greater than that for some of the others.

TAXONOMIC TREATMENT

This section presents a key to and descriptions of the species of *Carex* found in the Hawaiian Islands. The key is based on characters found in the mature-fruited inflorescence. The key may be followed using perigynia alone but, wherever feasible, additional characters of inflorescence and vegetative structure are included. The key is strictly an artificial one and no implications as to natural relationship are to be drawn from it. The distribution of the species may be more readily perceived by reference to the maps. The citations of specimens examined are followed by letters designating the herbarium in which they are found. These abbreviations follow the system proposed by Lanjouw (1939: 142). If no abbreviation is included, the specimens are in the Herbarium of the Bernice P. Bishop Museum, Honolulu, T. H. The abbreviations and the institutions in whose herbaria the specimens are deposited are as follows:

- C—Cornell University, Ithaca, New York
- GB—The Botanical Garden, Gothenburg, Sweden
- G—Conservatoire et Jardin Botanique, Geneva, Switzerland
- GH—Gray Herbarium, Harvard University, Cambridge, Massachusetts
- K—Kew Botanical Gardens, England
- KY—University of Kyoto, Japan
- NY—New York Botanical Garden, New York
- P—Museum National d'Histoire Naturelle de Paris, France
- US—Smithsonian Institution, Washington, D. C.
- TI—University of Tokyo, Japan

The illustrations have been selected to show the range of variation within each species and variety. Three different specimens

are illustrated for each species and two for each variety.

The maps are provided with legends explaining the symbols used. Where a symbol is half-shaded the location is considered only approximate. Only those locations which could reasonably be assigned to an area as small as 1 square mile are plotted.

KEY TO HAWAIIAN *Carex*

1. Perigynium trigonal to napiform; achene with a single, invaginate furrow at the equator 2
 Perigynium trigonal to lenticular; achene with no furrow at the equator 3
2. Teeth of bidentate beak over 1 mm. in length; beak and perigynium chartaceous, green, yellow, brown, not red-waxy
 . *C. wahuensis* var. *Meyeri* (p. 254)
 Teeth of bidentate beak under 1 mm. in length; beak or entire perigynium red-waxy
C. wahuensis var. *rubiginosa* (p. 257)
3. Stigmas 3; leaves stiff, erect, strongly involute or awl-shaped 4
 Stigmas 2; leaves flexuous, not normally involute or awl-shaped 5
4. Mature plants over 15 cm. tall; spikes with more than 10 achenes; not dwarfed; leaves clearly involute
 *C. montis-eeka* (p. 260)
 Mature plants under 15 cm. tall; spikes with fewer than 10 achenes; dwarfed; leaves awl-shaped
 . . *C. montis-eeka* f. *filifolia* (p. 262)
5. Perigynium multinerved, more than four nerves per side 6
 Perigynium at most three-nerved on a side or not nerved 9
6. Perigynium invaginate at the base, cordate; not stipitate
 *C. Svenonis* (p. 263)

- Perigynium not invaginate at the base; stipitate 7
7. Perigynium concave-convex, spindle-shaped, winged, non-glandular; beak strongly bidentate
 *C. Meyenii* (p. 264)
 Perigynium bi-convex, not winged; beak narrow, entire or subentire 8
8. Bracts strongly emarginate; perigynium ovate, strongly nerved, minutely glandular, not purple-black; spikes gynaeandrous
 *C. Nealae* (p. 267)
 Bracts acute to aristate, never emarginate, perigynium splotted with purple-black, not glandular, weakly nerved; spikes androgynous
 . *C. alligata* var. *Degeneri* (p. 278)
9. Perigynium winged, concave-convex; rostrum indistinct, tapering into the base of the perigynium; spikes short, forming a semiglobose terminal head 3 cm. in diameter or less
 . *C. macloviana* var. *subfusca* (p. 269)
 Perigynium not winged, bi-convex; beak distinct; spikes separate, over 3 cm. long, pendulant or erect, forming a branching inflorescence 10
10. Perigynium light brown or green, dull chartaceous to membranous
 *C. pluvia* (p. 271)
 Perigynium black or brown, highly polished, indurate 11
11. Perigynium brown or yellow-brown, lenticular; one nerve on one side raised to give a trigonal aspect
 *C. alligata* (p. 275)
 Perigynium black or purple-black; broad spindle-shaped, not nerved . 12
12. Perigynium not tightly packed in the spike, rachis visible, achene triangular in cross section, perigynia not stipitate
 *C. kauaiensis* (p. 279)

Perigynium tightly packed in the spike, rachis not visible, achene lenticular, perigynia stipitate . . .

. *C. pluvia* var. *koolauensis* (p. 274)

Carex wahuensis C. A. Meyer var. *Meyeri* Franchet and Savatier, Enum. Plant. Japon. 563, 1879.

Figs. 1a-c, 2

Carex wahuensis C. A. Meyer, Acad. St. Petersb., Mem. 1:218, Tab. 10, 1831.

Carex Boottiana Hooker and Arnott, Bot. Beech. Voy., 273, 1841.

Carex nupitalis Boott, Illust. Genus Carex 4, 175, pl. 591, 1867.

Rootstocks caespitose forming dense clumps to 50 cm. in diameter; basal scales 0.5-1.5 cm. wide, 1.4-4 cm. long, 4-8 per culm, soon becoming loose, fibrillose, dark brown; fertile culm 2-4 mm. wide, 15-100 cm. long, isosceles triangular in cross section, lightly scabrous or smooth on the main veins and angles, erect, heads nodding; leaves 2-15, usually 6-7, mm. wide, 5-10 cm. long, 5-8 per culm, erect for about one-third the length, scabrous and toothed on all main veins on the underside, glabrous above, shiny, dark green to yellow; sheaths loose, dark brown to reddish, closed by a dark membrane extending 4-8 cm. above the rootstock, splitting along the membrane at maturity; inflorescence 4-25 cm. long, branching, 1-4 unbranched spikes arising from a node, 2-15 nodes per culm, internodes 2-6 cm. long at the base shortening toward the apex, each node and peduncle enclosed by the base of a leafy bract; spikes 0.5-1.5 wide, 2-10 cm. long above the peduncle, androgynous except the terminal one at each node which may be entirely staminate, 1 to 3 spikes at a node enclosed by leafy bract, peduncles 2-5 cm. long, enclosed at the base by an ochrea 10-15 mm. long; pistillate bracts ovate, truncate at the base, 2-3 mm. wide, 2.5-5 mm. long, awned, hyaline on margins, red or brown membranous in the center, keeled, awns 2.5-

5 mm. long, awl-shaped, toothed on margins; staminate bracts 2-5 mm. long, hyaline, keeled, awns 2-4 mm. long, toothed; perigynia 2-3.5 mm. wide, 3-8 mm. long, with

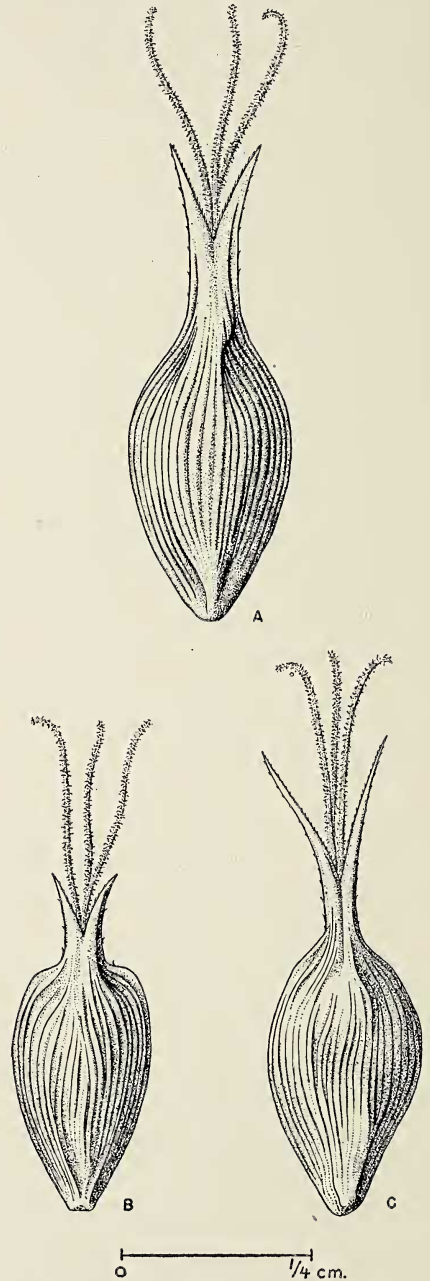


FIG. 1. Perigynia of *Carex wahuensis* C. A. Meyer var. *Meyeri* Franch. and Sav. a, Krauss 161; b, Hitchcock 15327; c, Christophersen 3695.

body obovoid, rarely bluntly stipitate though this condition not shown in the illustration; 20–30 nerved on a side, dull chartaceous, green to yellow or brown, rostrum 1–4 mm. long, minutely toothed on the upper third, bidentate, two teeth 0.9 mm. to 3 mm. long, spreading subulate; achene a double three-sided pyramid, distorted, invaginate at the middle or equator more strongly on one side, ridged on the angles, the planes slightly convex or concave, beak usually bent, 0.5–1 mm. long; style 1–2 mm. long, rising at right angles or less from the beak, dividing into three stigmas 2–3 mm. long.

Distribution: On all islands in Zone D of Ripperton and Hosaka (1942) in the middle forest zone in shade or on open ridges in full sun, on soil or damp rocky ravine walls.

Type: Illustrated by C. A. Meyer (1831: Table 10). The type specimen is deposited in the herbarium at Leningrad.

Specimens examined

KAUAI: *Degener* 2214, Olokele Canyon, July 3, 1926, (NY); *Degener* 2207, Hana-

pepe Falls, June 19, 1926, (NY); *Degener* 2205, NE of Kipu, June 17, 1926, (NY); *Fagerlind & Skottsberg* 6567, Kokee near stream opposite Phillip Rice's summer house, Mar. 12, 1948 (GB); *Heller* 2849, on Kaholuamanoa above Waimea, Oct. 1–8, 1895 (K, US); *Hitchcock* 15327, Kaholuamano, 3500', Oct. 20, 1916 (US); *MacDaniels* 723, Haupu, 300 m., Feb. 16, 1927; *Nuttall*, Attooi [= Kauai] (K); *St. John* 10893, Maunapulo, Hanakapiai, Napali Coast, Dec. 30, 1930; *St. John* 10817, Nualolo Trail, 2900', Dec. 28, 1930; *St. John* 13619, Kipu, 1100', Dec. 25, 1933; *St. John* 23087, Olokele Ditch Trail, 2 mi. below Ditch House, Dec. 26, 1947; *St. John* 23142, rocky base of cliff, Waiahuakua Valley, 1500', Dec. 29, 1947; *St. John* 22880, Waimea Trail, Kokee, 3700', Dec. 21, 1947; *St. John* 23194, West branch of Hanakoa Valley, 1000', Dec. 31, 1947; *St. John* 23078, Olokele Ditch Trail, 1427', Dec. 26, 1947; *St. John & Fosberg* 13717, Milolii Ridge, 1600', Dec. 27, 1933; *St. John & Fosberg* 13718, Milolii Ridge, 2000', Dec. 27, 1933; *Skottsberg* 1043, Olo-

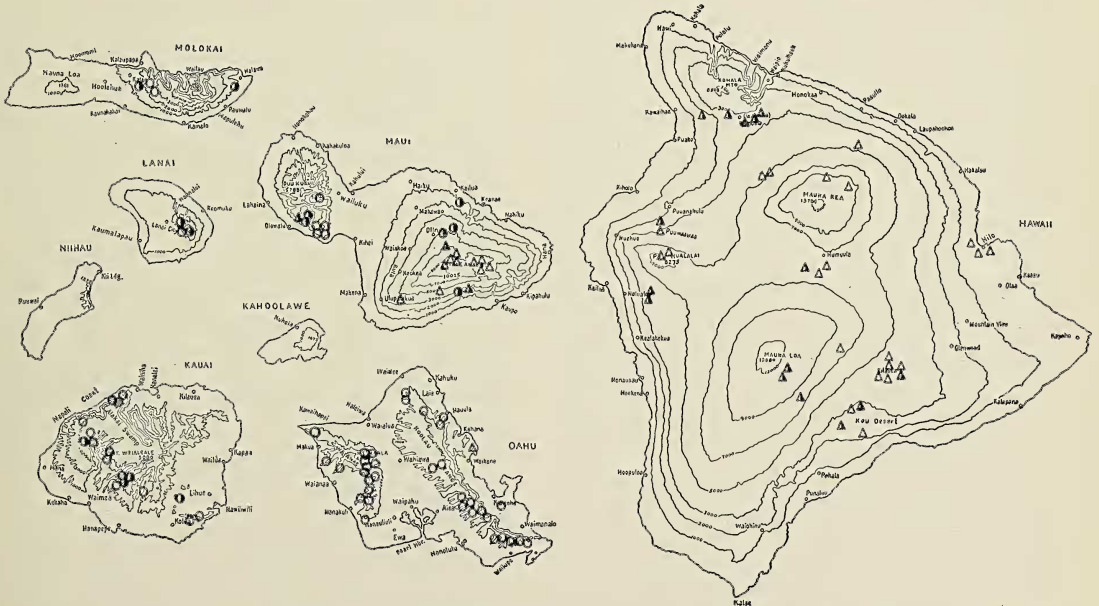


FIG. 2. Distribution of *Carex wabuensis* C. A. Meyer var. *Meyeri* Franch. and Sav. (indicated by circles) and of *C. wabuensis* C. A. Meyer var. *rubiginosa* R. Krauss (indicated by triangles).

kele Canyon, Oct. 21, 1922; *Smith, Whiting, Neal, Kokee*, 3500', May 1, 1929.

OAHU: *Bryan* 706, Mt. Kaala, 900 m., Apr. 21, 1929; *Christophersen* 3677, below Kanehoa, 400 m., June 1, 1932; *Christophersen* 3695, below Kanehoa, 350 m., June 1, 1932; *Christophersen, Wilder, Hume* 1526, Kuliouou, 450-600 m., Feb. 5, 1931; *Christophersen, Wilder, Hume* 1549, below Puu Kapu, 350-500 m., Feb. 12, 1931; *Cowan* 851, ¼ mi. N of Puu Kaua, Feb. 29, 1948; *Cowan* 955, Halawa Ridge Trail, Apr. 25, 1948; *Cowan* 814, ridge trail to Palikea, Feb. 4, 1948; *Degener* 8272, head of Kuliouou Valley, Dec. 11, 1927, (NY); *Degener* 8218, small valley E of Palikea, Oct. 23, 1932, (NY); *Degener* 5268, Kolekole Pass, May 1, 1926, (NY); *Degener* 8220, top of Kaena Pt., Jan. 31, 1932, (NY); *Degener* 8221, Pupukea, Kahuku Trail, Pupukea side, Mar. 30, 1927, (NY); *Degener* 8281, near summit of Kaala, Feb. 11, 1928, (NY); *Degener* 5263, E ridge of Manoa Valley, Feb. 6, 1927, (NY); *Degener* 8219, first gully S side of Keaau Valley, Feb. 7, 1932, (NY); *Degener* 19581, Mokuleia mauka, 2000', May 2, 1949; *Fagerlind* 6459, trail to Puu Kaua, Feb. 29, 1948, (GB); *Forbes* 1471.0, Lanihuli Trail, Mar. 15, 1910; *Forbes* 2518.0, Waialae Valley, Jan. 8, 1919; *Forbes* 2425.0, Waialae iki, Feb. 28, 1917; *Forbes* 2466.0, ridge between Niu and Wailupe, Apr. 11, 1917; *Forbes* 2523.0, Wailupe, Jan. 1919; *Fosberg* 13552, Kailua, Ulumawao, 130 m., Jan. 24, 1937; *Fosberg* 12281, Nuuanu Pali, 370 m., Oct. 14, 1935; *Fosberg* 9273, Palolo Valley, 425 m., Mar. 19, 1933; *Fosberg* 13799, Nanakuli Valley Head, 825 m., May 2, 1937; *Fosberg* 13007, Puu Kalena, 930 m., Mar. 22, 1936; *Heller* 2389, lower slopes of Waiolani, June 6, 1895; *Hillebrand* 560, Nuuanu Valley, 1860-67; *Hitchcock* 13788, Nuuanu Pali, June 17, 1916; *Hitchcock* 14049, Nuuanu Pali, July 19, 1916; *Hosaka* 540, Kipapa, 1000', May 15, 1932; *Hosaka* 948, Kipapa Gulch 1800',

Mar. 19, 1933; *Hume* 482, Puu Kanehoa, 1500', Jan. 18, 1932; *Krauss* 183, SE slope of Kaala, 3000', Apr. 18, 1948; *Krauss* 247, trail along Wiliwilinui ridge, 1450', June 28, 1948; *Krauss* 243, trail along Wiliwilinui ridge, 1300', June 28, 1948; *Krauss* 126, trail to Puu Kaua, 2800', Feb. 29, 1948; *Krauss* 123, trail to Puu Kaua, 3000', Feb. 29, 1948; *Krauss* 121, trail to Puu Kaua, 3000', Feb. 29, 1948; *Krauss* 140, ridge S of Maakua Gulch, 800', Mar. 21, 1948; *Krauss* 161, Palikea, 2800', Mar. 26, 1948; *Krauss* 114, Palikea, Feb. 4, 1948; *Krauss* 109, Palikea, Feb. 4, 1948; *Krauss* 108, Palikea, Feb. 4, 1948; *Krauss* 188, Kaala, 3000', Apr. 18, 1948; *Krauss* 196, Kaala, 2000', Apr. 18, 1948; *Krauss* 197, Kaala, 2000', Apr. 18, 1948; *Krauss* 198, Kaala, 3000', Apr. 18, 1948; *Krauss* 199, Kaala, 2500', Apr. 18, 1948; *Krauss* 111, Palikea, 3000', Feb. 4, 1948; *Krauss* 140, ridge of Maakua, 600', Mar. 21, 1948; *Krauss* 561, N fork of Elehaha Stream, 865', Apr. 16, 1949; *Nuttall*, Oahu, (K); *Remy* 142, Oahu, 1851-55, (GH, P); *St. John* 10440, Puu Hapapa, Waianae Mts., 2800', Mar. 16, 1930; *St. John* 21569, Waimanalo, 750', Mar. 24, 1946; *St. John* 10385, Palikea, 1200', Feb. 23, 1930; *St. John* 17612, Puu Kawiwi, 2800', Mar. 31, 1935; *St. John* 20182, Kaluanui Ridge, 1500', Feb. 16, 1941; *St. John* 13154, Pohakea Pass, 2100', May 12, 1933; *St. John* 10441, Puu Hapapa, 1700', Mar. 16, 1930; *St. John* 14059, E of Puu Kanehoa, 2350', Jan. 7, 1934; *St. John* 13047, Laie-Malaekahana ridge, 1100', Apr. 15, 1933; *St. John* 11044, Puu Kanehoa, 2700', Mar. 22, 1931; *St. John* 14018, Puu Kanehoa, 2700', Jan. 7, 1934; *St. John* 13037, Kalauao ridge, 1500', Mar. 29, 1933; *St. John* 11069, Puu Kanehoa, 2000', Apr. 22, 1931.

MOLOKAI: *Degener* 8239, ravine NW of Mauna hui, May 27, 1928; *Degener* 8238, Kahuaawi Gulch, May 12, 1928; *Degener*, 8230, ravine, S of Mauna hui cabin, Apr. 15,

1928; *Fagerlind & Skottsberg* 6376, along road from Mapulehu to Halawa, E coast, Feb. 20, 1948, (G).

LANAI: *Fagerlind & Skottsberg* 6418, W side of main ridge near Munro's old place, Feb. 24, 1948, (G); *Hitchcock* 14690, ravine at foot of mountain, Sept. 21, 1916, (US); *Munro* 408, Pohaku, Feb. 27, 1915, (US); *Munro* 297, Kaiholena, Feb. 17, 1914; *St. John & Cowan* 22609, SW ridge of Kaiholena Gulch, Kamoku, 2300', Apr. 4, 1947; *St. John & Cowan* 22612, SW ridge of Kaiholena Gulch, Kamoku, 2200', Apr. 4, 1947.

MAUI: *Degener* 8244, Manawainui Gulch near Puu Anu, dry side, July 12, 1927, (NY); *Degener* 8243, Manawainui Gulch near Puu Anu, dry side, July 12, 1927, (NY); *Degener* 8246, ridge N of Popakea Gulch, July 23, 1927, (NY); *Degener* 8254, hill mauka of Olinda, June 15, 1927, (NY); *Degener* 8247, ridge N of Popakea Gulch, July 23, 1927, (NY); *Degener* 8249, along pipe-line trail, Olinda, June 22, 1927, (NY); *Forbes* 2338.M, Olowalu Valley, May 2, 1920; *Forbes* 2285.M, Olowalu Valley, May 9, 1920; *Forbes* 2339.M, Olowalu Valley, May 12, 1920; *Forbes* 1862.M, Waiopaa Ranch, Nu'u, Mar. 6, 1920; *Remy* 143, Maui, 1851-55, (P); *Rock* 8747M, Makaima, Apr. 1911; *Rock* 8753M, shore at Nahiku, May 10, 1911; *St. John* 10280, Iao Valley, 1200', Feb. 9, 1930.

HAWAII: *Spach*, Owhyhee, Jan. 1859, (K).

SANDWICH ISLANDS: *Hillebrand* (Erroneously as Hillebrant) 2328, Sandwich Islands, 1860-67, (US), (immature).

Carex wahuensis C. A. Meyer is a member of the subgenus *Eucarex* Coss. & Germ. (Kükenthal, 1909: 293) section *Rhomboidales* Kükenth. (Kükenthal, 1909: 622). It is easily distinguished from the other Hawaiian species by the deep groove in the achene. Its apparent origin is in the western Pacific, the Hawaiian members being only slightly different from those of Japan. Names placed in synonymy were created by authors who

felt they could segregate new species or by those who received specimens from areas distant from Oahu and expected no similarity. These are *Carex Boottiana* Hooker and Arnett (Hooker, 1841: 273) collected from Japan, and *Carex nupitalis* Boott (Boott, 1855: 175) from Hawaii. Boott was misled by the distorted appearance of the immature fruit so clearly shown in his Plate 591. This plate is based on *Remy* 142 from Oahu and on a single spike from Nuttall's collection. Variety *Meyeri* of Franchet and Savatier was made after an examination of the species collected in the Hawaiian Islands and those from Japan and the Bonins. The variety *Meyeri* was apparently created from the material of Remy in order to have a contrasting variety to variety *robusta* from Japan and variety *Bongardii* from the Bonins. The only citation of the habitat of variety *Meyeri* is "ex speciminibus herbarii Mus. Parisiensis." Earlier in their discussion of the contrasting characters of the two varieties *robusta* and *Bongardii* as opposed to those in the species, they mention that they are compared to the plants collected by Remy in the Paris Herbarium. It is apparent that the intent of Franchet and Savatier was to make a variety corresponding to variety *typica* as now used. The International Rules, in Recommendation 18, specify that new names should not be used for the variety containing the type of the species but instead such names as *typicus*, *genuinus*, etc. The use of another name for the typical variety is not definitely prohibited, however. Therefore the variety *Meyeri* must be accepted as the variety of *Carex wahuensis* C. A. Meyer containing the original species.

The type specimen was not seen but C. B. Clarke (1904: 319) in his discussion of *Carex Wilfordii* C. B. Clarke says that the type corresponds well with Tab. 10 of Meyer. *Carex wahuensis* C. A. Meyer var. *rubiginosa* var. nov.

Figs. 2, 3a-d

A specie differt in utriculis 2.5-4 mm. latis,

3–8 mm. longis trigonis obovoideis aut obnapiformis valde multinervis ad debilitibus nervosis, in rostris et prope omnis corporis

utriculis rubri-cereis, rostris 1.5–3 mm. longis bidentatis angustis, dentibus 0.15–0.9 mm. longis, — 0.9 mm. longis solum in exemplis grandissimis.

Similar to the species except in following characters: Perigynia 2.5–4 mm. wide, 3–8 mm. long, broad-obovoid to obnapiform tapering to a truncate base, roughly 3-angled strongly multi-nerved or obscurely several-nerved, bright red-waxy on rostrum and usually on most of the surface of the perigynium, rostrum bidentate, 1.5–3 mm. long, narrow, teeth 0.15–0.9 mm. long, approaching 0.9 only in very large individuals.

Distribution: On Hawaii, Maui, rarely Oahu, in Zones D and E of Ripperton and Hosaka (1942), in the upper forest in dry sunny cliff faces and open meadows, seldom in shade, usually over 4,000 feet.

Type: *H. St. John*, *R. S. Bean*, and *E. Y. Hosaka* 11228, Kilauea Iki, 3930' alt., Dec. 21, 1931.

Specimens examined

OAHU: *St. John* 11080, Kaaawa Valley, 800', Apr. 12, 1931.

MAUI: *Degener* 5262, Haleakala, (NY); *Degener* 8241, N of Ulupalakua, July 4, 1927, (NY); *Degener* 8250, Haleakala near Koolau Gap, June 29, 1927, (NY); *Degener* 8265, Koolau Gap, Haleakala Crater, Aug. 11, 1927, (NY); *Degener* 8270, Haleakala Crater, Aug. 9, 1927, (NY); *Forbes* 296.M, Haleakala, Aug. 1910; *Forbes* 698.M, NE of Ukulele, July 9, 1919; *Forbes* 1089.M, Haleakala Crater, Aug. 8, 1919; *Forbes* 2285.M, Olowalu Valley, May 9, 1920; *Forbes* 1876.M, Waiopaa Ranch, Mar. 6, 1920; *Forbes* 1887.M, Puu Pani, Mar. 8, 1920; *Forbes* 2104.M, Auwahi, S slope of Haleakala, Mar. 24, 1920; *Forbes* 2141.M, Puu Ouli, Haleakala, 4300', Apr. 4, 1920; *Forbes* 2143.M, Puu Ouli, Haleakala, 4300', Apr. 4, 1920; *Fosberg* 9928, Haleakala between bottomless pit and pali, 2150 m., Sept. 23, 1933; *Hillebrand*, Haleakala, (K); *Hil-*

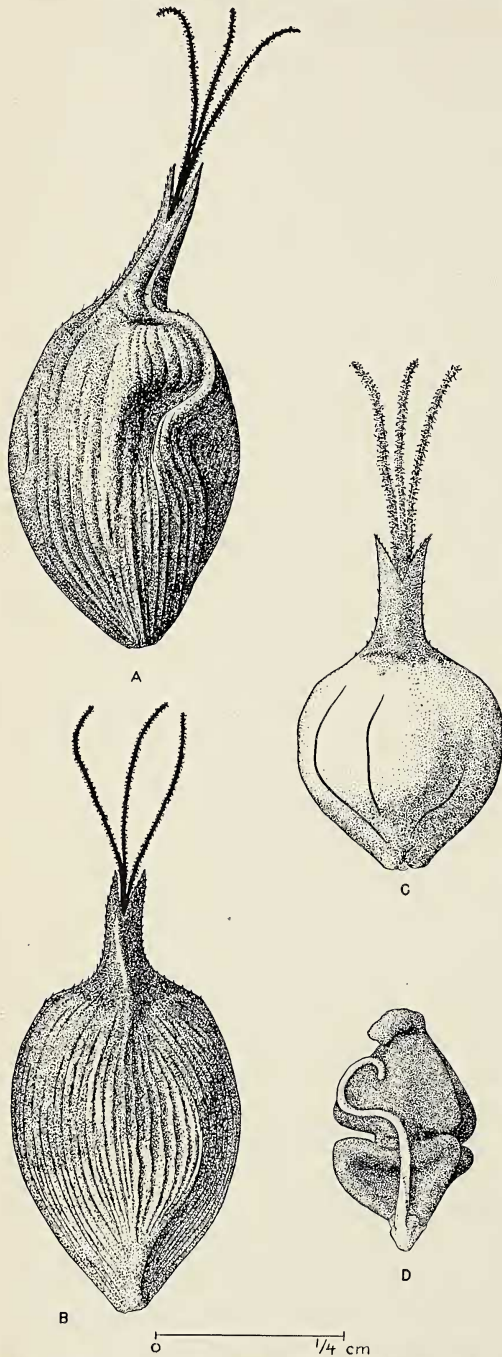


FIG. 3. *Carex wahuensis* C. A. Meyer var. *rubiginosa* R. Krauss. a-c, perigynia; d, achene. a, *Degener* 2218; b, *Forbes* 172.H; c, d, *Krauss* 348.

lebrand 531, Haleakala, 7000', (K); *Krauss* 346, cliffs above Holua, 7000', Sept. 3, 1948; *Krauss* 348, cliffs above Holua, 7000', Sept. 3, 1948; *Krauss* 349, cliffs above Holua, 7000', Sept. 3, 1948; *Krauss* 352, cliffs above Holua, 7000', Sept. 3, 1948; *Remy* 144, 1851-55, (P); *Rock* 8750, Haleakala, 8000', Apr. 20, 1911.

HAWAII: *Degener* 2218, E of Kilauea-iki, July 17, 1926, (NY); *Degener* 2217, 17 mi. from Kohala to Waimea, July 31, 1932, (NY); *Degener* 2215, between N Kona and Kau Desert, July 15, 1926, (NY); *Degener* 2219, W of Kilauea along Kau Rd., July 21, 1926, (NY); *Degener* H103, Haw. Nat'l Park, moist forest near Kilauea-Iki, Dec. 21, 1922, (NY); *Degener* 19262, Nenenui, central plateau, Sept. 17, 1948, (NY); *Ewart* 326, Hanaipae, 5000', Feb. 14, 1934; *Fagerlind* & *Skottsberg* 6242, truck road between Kilauea and Mauna Loa, 6000', Feb. 2, 1948, (GB); *Faurie* 1214, shore of Hilo, May 1909, (G); *Forbes* 172.H, Hanehane, Kona, June 15, 1911; *Forbes* 914.H, Flow of 1880, Kipuka-ahui, June 23, 1915; *Forbes* 9039.H, Mauna Kea above Lai Niaia, June 18, 1915; *Fosberg* 10114, between Makaopuhi and Napau Craters, Kilauea, 890 m., Aug. 29, 1933; *Hillebrand* 1960, Hilo, (US); *Hillebrand* 532, Hilo, (K); *Hinds* 2, 1841, (K); *Hitchcock* 14433, Humuula Sheep Station, 6000', Aug. 27, 1916, (US); *Hitchcock* 14477, Puu Waawaa, Aug. 30, 1916, (US); *Hitchcock* 15592, Hualalai Mt. summit, Aug. 25, 1916, (US); *Hitchcock* 14224, Kukaiau Ranch, 3600', Aug. 20, 1916, (US); *Hitchcock* 14283, Mauna Kea, N side, 800-1000, Aug. 22, 1916, (US); *Judd*, Waikii, July 21, 1928; *Macrae*, Kaaha, June 1825, (K); *Mann & Brigham* 328, summit of Hualalai, 1867, (G); *Meebold*, Kipuka Puauulu, Kilauea, May 1932; *Neal & Hartt* 666, Base of Puu Hulukulu, 6610', Aug. 6, 1935; *Nuttall* 3, (K); *Remy* 145, 1851-55, (P); *Rock* 8741, Kilauea Volcano, Apr. 1911; *Rock* 8411, Waikii, June 1910; *Rock* 8742, Kilauea

Volcano, Apr. 1911; *Rock* 10042, Pulehua, Jan. 1912; *St. John* 11333, Manuka Mauka, 1700', Dec. 26, 1931; *St. John, Bean, and Hosaka* 11228, (See Type); *St. John & Cowan* 22312, Halfway House, Kau Desert, 2900', Dec. 23, 1946; *St. John* 11220, chain of craters, Napau Trail, 2750', Dec. 30, 1931; *Skottsberg* 1103, between Kilauea and Kapapala, Sept. 18, 1922, (GB); *Skottsberg* 633, S slope of Hualalai, 1200 m., Sept. 23, 1922, (GB); *Skottsberg* 633b, Hualalai, 2000 m., Sept. 24, 1922, (GB); *Skottsberg* 1874, Kilauea Iki, Sept. 21, 1926; *Skottsberg* 517, E slope of Mauna Loa, Sept. 15, 1922; *Wilkes Exped.*, crater W Lua Pele, 1838-42, (US); *Wilkes Exped.*, district of Waimea, 1838-42, (US); *Wilkes Exped.*, Mauna Loa, 1838-42, (US); *Wilkes Exped.*, Mauna Loa, above 8000' station, 1838-42, (US).

SANDWICH ISLANDS: *Hillebrand* 2325, Sandwich Islands 1860-67, (US); *Hillebrand* 2327, Sandwich Islands 1860-67, (US).

Carex wahuensis Meyer var. *rubiginosa* is the only possible segregate in this species. A detailed tabulation, with careful measurements and repeated observations, was made of each specimen examined. It soon became apparent that the population was one of many different biotypes varying in stature as well as in floral structure. Every possible character was used to separate the plants into logical natural groups. Only two characters seemed usable and they were occasionally difficult to distinguish even to the trained eye. One is the red-waxy color of the perigynia of plants from Hawaii and Maui. The other is the very short teeth, usually only 0.5 mm. in length, of the beak of the perigynia. Other characters believed infallible in *Carex*—such as structure and shape of the perigynia, setaceousness of the rostra, and complexity of inflorescence—proved unreliable. A surprising number of apparently teratological forms occurred in various collections as follows:

Hosaka 540, Kipapa Gulch, Waipio, S ridge, 1000', May 1932: a complete androgynous spike arising from a perfectly formed utricule

Krauss 348: an extension of the axis within the perigynia reminiscent of the barb in *Uncinia*

Rock 8753, at the shore, Nahiku, Maui, May 10, 1911: a compounding of the spikes by numerous branchings from the base of each normal one to form a dense head

Forbes 1862.M: extremely large fruit as much as three times as large as normal

Carex montis-eeka Hillebrand, Flora of the Hawaiian Islands 486, 1888.

Figs. 4a-c, 5

Carex montis-eeka Hillebd. var. *viridens* Kükenth., Fedde Rep. 16: 435, 1920.

Rootstocks loosely caespitose; basal scales 7-8 mm. wide, 10 cm. long, 2-5 per culm, reddish, persistent; fertile culm, 2-3 mm. wide, 75 cm. long, with cross section triangular to semicircular, smooth, strongly veined, hollow, distinct from the leaves near the base, stiffly erect; leaves 1-2 mm. wide, 70 cm. long, 5-8 per culm, stiffly erect, clumped, strongly involute, glabrous, dark green; sheaths 15 cm. long, closed by a tight hyaline membrane; inflorescence 5-10 mm. wide, 2-7 cm. long, with 2-5 nodes, one spike to a node, lower internodes 1-3 cm. long, upper internodes shortened to 1-2 mm., or all spikes arising from a common terminal node; spikes androgynous except terminal spike which is staminate, 3-5 mm. wide, 1-3 cm. long, sessile or short pedunculate with an open ochrea at the base adjacent to the culm; pistillate bracts 1.5 mm. wide, 3 mm. long, ovate, chartaceous, 1-3-nerved, glabrous, green to brown; staminate bracts 4-5 mm. long, lanceolate, acuminate, 1-3-nerved; perigynia ovoid to lanceoloid, concave-convex to bi-convex, 1.5-2 mm.

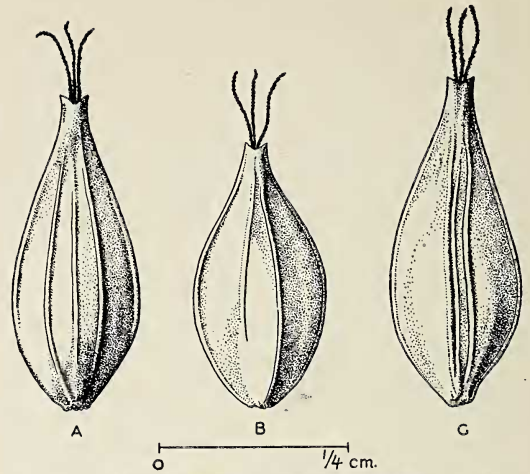


FIG. 4. Perigynia of *Carex montis-eeka* Hillebd. a, *Forbes 418.K*, b, *Fosberg 10039*; c, *Degener 8264*.

wide, 3-5 mm. long, toothed on the upper third of the margin, otherwise smooth, 1-3 nerved near the center on the convex side, singly nerved or not nerved on the concave side, rostrum tapering to a shallowly bidentate apex; achenes isosceles triangular in cross section, obovate, 2-2.5 mm. wide, 1.5 mm. long, truncate at the base, rugose, smooth and slightly ridged at the angles, light brown, rostrum 0.2 mm. long, bent back on the achene; style 1 mm. long dividing into three stigmas 2-3 mm. long, dark brown, glandular.

Distribution: on Kauai, Molokai, and Maui, in Zones D₃ and E₁ (Ripperton and Hosaka, 1942), the middle forest bog zone, in extremely wet, high bogs above 3,800 feet or in ponds in the bogs.

Lectotype: *J. F. Rock 8190*, summit of Puu Kukui, West Maui, Aug. 21, 1910.

No types or isotypes collected by William Hillebrand are available. The specimens were in the Berlin Herbarium, which was destroyed by fire in 1944. The entire collection of the Cyperaceae was lost. The collection of Rock cited above as the lectotype is from the same area as that cited by Hillebrand and contains many duplicates. It has been established that

the Hillebrand specimens cited as being from Mt. Eke are actually from Puu Kukui, the only area in which he collected in this high bog region.

Specimens examined

KAUAI: *Cranwell, Selling, and Skottsberg* 2870, Alakai between Lehua makanoe and Kilohana, Aug. 15, 1938; *Degener* 2204, Waineke, June 28, 1926, (NY); *Faurie* 1204, Hanapepe, Dec. 1909, (KY); *Forbes* 418.K, Kaholuamanu behind Waimea, Sept., 1908; *Forbes* 881.K, Alakai Swamp, Waimea drainage basin, west side, July 3–Aug. 18, 1917; *Forbes* 1155.K, Alakai Swamp, Waimea drainage basin, July 3–Aug. 18, 1917; *Hitchcock* 15488, Waialeale, 3600–5080', Oct. 22–24, 1916, (K); *Hitchcock* 15515, Kauluwehi Swamp, near Kaholuamanu Bog, Oct. 25, 1916, (K); *Rock* 9016, Kauluwehi Swamp, Waimea drainage basin, July 3–Aug. 18, 1917; *St. John* 10773, NW end of Alakai Swamp, Na Pali, 3800', Dec. 27, 1931; *St. John* 13569, Kahili Bog, 2100', Dec. 24, 1933; *Skottsberg* 943, Alakai Swamp near Kilohana, 1500 m., Oct. 27, 1922.

MOLOKAI: *Cranwell, Selling, Skottsberg* 2529, Pepeopae Bog, July 7, 1938; *Degener* 8235, Pepeopae Bog, May 3, 1928, (NY); *Degener* 8237, Pepeopae Bog, May 8, 1928, (NY); *Forbes* 199.Mo, mountains above Puu Kolekole, July 1912; *Hitchcock* 15192, central Molokai bog, 4000', Oct. 13, 1916; *Munro* 379, above Pelekunu, May 6, 1916; *Munro*, Kaunakakai, Jan. 1904; *St. John* 12560, Kawela ridge between Hanalilolilo and Pepeopae, 4100', Dec. 25, 1932.

MAUI: *Bryan* 641, Puu Kukui, 5200', Dec. 20, 1928; *Degener* 8258, Mt. Ekee, Aug. 29, 1927, (NY); *Degener* 8257, Mt. Ekee, Aug. 30, 1927, (NY); *Degener* 8264, Mt. Ekee, Aug. 27, 1927, (NY); *Ewart* 78, Puu Kukui, pond, 4800', Dec. 18, 1928; *Ewart* 45, Puu Kukui, 5700', Dec. 20, 1928; *Forbes* 465.M, Eeke-Honokahau drainage basin, Sept. 25–Oct. 1917; *Forbes* 1182.M,

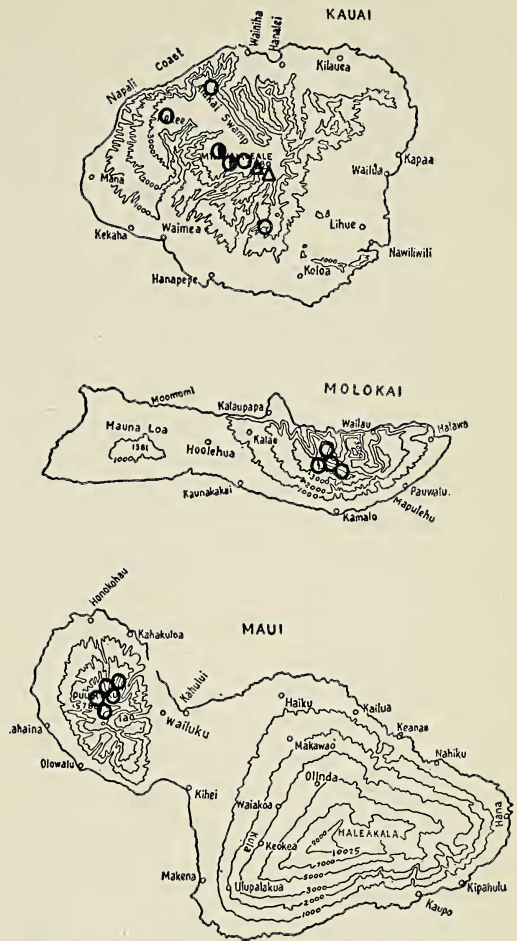


FIG. 5. Distribution of *Carex montis-eeka* Hillebd. (indicated by circles) and of *C. montis-eeka* forma *filifolia* (Skotts.) R. Krauss (indicated by triangles).

Waianapanapa Haleakala, Aug. 20, 1919; *Fosberg* 10039, Puu Kukui, pool, 1700 m., Aug. 24, 1933; *Hitchcock* 14840, Puu Kukui, 5000', Sept. 24–26, 1916; *Krauss* 424, Puu Kukui, 5500', Sept. 8, 1948; *Krauss* 468, Puu Kukui, 5300', Sept. 10, 1948; *Rock* 8190, Summit of Puu Kukui, Aug. 21, 1910; *St. John* 10262, Puu Kukui, 5750', Feb. 7, 1930; *Skottsberg* 741, top bog of Kukui, 1800 m., Sept. 10, 1922.

Carex montis-eeka Hillebd. is the only Hawaiian representative of section *Extensae* Fries (or *Spinostachyae* of Drejer) (Küken-

thal, 1909: 657). The section is widespread, occurring on all the continents, with a particular complex in Australia. As judged from written descriptions and plates *Carex montis-eeka* Hillebd. seems to approach *Carex serotina* Merat. (*Carex Oederi* Retz.) (Kükenthal, 1909: 301–303). It differs in the central nature of the perigynial veining, and in the extreme rigidity of the culm and involute leaves found in *Carex montis-eeka* Hillebd.

Skottsberg (1944: 333) uses the spelling *montis-Eke*, applying Article 70 of the International Rules of Nomenclature. The capitalization of Eke is permissible (Art. 70, note 1), but there is no indication that "eeka" is an unintentional typographic or orthographic error even if it may be a corruption of the present spelling for Mount Eke. The original spelling must be retained in the absence of such proof.

Kükenthal (1909: 435) describes *Carex montis-eeka* var. *viridens* as follows: "Squamae tenuiores pallidiones. Utriculi squamos large superantes oblique patentes virides nitidi oblongo elipsoidei, in rostrum magis conspicuum emarginatum abeuntes. Sandwich Inseln: Kauai, Hanapepe (Faurie no. 1204)." The type was secured and examined for these characters. The bracts are scarcely shorter than the large perigynia. They are slightly more hyaline than is usual but certainly not exceptional enough to indicate genetic difference. The rostra are only slightly more strongly bidentate than those in the rest of the population. Other Kauai specimens were examined to determine the constancy of the characters given. *Cranwell, Selling, and Skottsberg* 2807, collected in the region of the Faurie number, has the characters given by Kükenthal. The perigynia exceed the bracts by at least half their length; they are at an oblique angle with the rachis; they are green and shiny; and there is a slight groove in the rostrum. From the fresh stigmas it is clear that this is an immature specimen. The scales are still green and in growing condi-

tion, the lower older ones already much larger than the upper ones. The characters given are all those of a young inflorescence. None of the other Kauai specimens shows these features except in the more immature spikes.

Carex montis-eeka Hillebrand f. *filifolia* (Skottsberg) comb. nov.

Fig. 5

Carex montis-Eke var. *filifolia* Skottsberg, Acta Horti. Gotob. 15: 333, 1944.

Fruiting plants like those of the species but dwarfed; fertile culms 10–12 cm. tall, rarely to 33 cm. tall; leaves 0.1–0.5 mm. wide, 10–15, rarely 25, cm. tall, awl-shaped, channeled; inflorescence of 2–3 spikes, 3–6 perigynia per spike.

Type: L. M. Cranwell, O. Selling, C. Skottsberg 3042, summit of Waialeale, Kauai, Aug. 23, 1938.

Species examined

KAUAI: *Cranwell, Selling, Skottsberg* 3059, summit region of Waialeale, Aug. 23, 1938; *Cranwell, Selling, Skottsberg* 3042, (See Type); *Rock* 12754, Waialeale Swamp, Oct. 10, 1911.

Carex montis-eeka Hillebrand var. *filifolia* Skottsberg is retained as a form although only three specimens have been collected and one of these is less distinct than the others. Essentially, the difference is in the dwarf filiform aspect of the vegetative parts. Inspection of the plants, however, indicates that the rhizome is an old one and the growth habit is constant. The plant is found only on Mount Waialeale in Kauai well within the geographic and ecologic range of the species.

The variety is being reduced to a form not out of a desire arbitrarily to change categories but from the belief that this form is an unusual biotype of the species only ecologically modified to the stature at hand. Further collections of a large mass of material

of this form might indicate that it is a true variety with hereditary characters. On the other hand further collections of intermediates would validate the view now taken or cause complete union of this population with that of the species.

Carex Svenonis Skottsberg, Acta Horti. Gotob. 15:329-333, 1944.

Figs. 6a-c, 7

Carex Svenonis var. *alakaiensis* Skottsberg, Acta Horti. Gotob. 15:330-333, 1944.

Rootstocks caespitose, freely branching; basal scales 2-3 mm. wide, 0.5-2.5 mm. long, 1-3 per culm, fibrillose, caducous, brown, many fertile culms in a tuft (10-15 per 16 sq. cm.); fertile culm unequally trigonal, slender, broadest side 0.5-0.9 mm. wide, 25-30 cm. long, faces slightly concave, glabrous, pendent to erect; leaves filiform to slender, pendent at the ends, three-sided, deeply grooved on one side near the base, slightly so at the tip, scabrous on the three sides, light green; sheaths broad, membranous, enclosing culm and younger leaves up to 8 cm. above the rootstock, tight, brown to green; inflorescence 5 mm. wide, 2-5 cm. long, 3-7 spikes per culm, one spike per node, the lower nodes 1 cm. apart, the upper closer, each spike subtended by a leafy bract

which narrows at once to a filiform, scabrous awn, 0.5-8 cm. long; terminal spikes staminate, lateral spikes androgynous, gynaeandrous, or both, 3-4 mm. wide, 3-12 mm. long, sessile, subtended within the leafy bract by a large bract or scale; pistillate bracts 1.5 mm. wide, 1.5-2.8 mm. long, broad ovate to triangular, hyaline with a single broad, dorsal nerve, acuminate, smooth on margins; staminate bracts similar, slightly reduced; perigynia 1-1.5 mm. wide, 1.5-3.5 mm. long, ovoid, convex-concave, strongly invaginate or cordate at the base, sessile or short stipitate, distinctly 5-9-nerved, glabrous, rostrum indistinct, scarcely separate from the gradually tapering body, broad, toothed, the apex unequally shallowly bidentate, frequently splitting down the entire length of the perigynia along a weakened line in the center of the convex side; achenes ovate, stipitate, glabrous, tan; style 0.5 mm. long, dividing into two stigmas 2-3 mm. long, tapering, glandular, reddish.

Distribution: Hawaii and Maui above 5,000 feet in Zones D₃ and E of Ripperton and Hosaka (1942), in bogs or wet regions of the upper forest.

Type: S. Berggren, Aug. 1875, Hawaii, in silva montis Mauna Kea.

Specimens examined

MAUI: Forbes 1181.M, Bog below Waianapanapa, Aug. 20, 1919.

HAWAII: Degener 19223, 29 miles, Kilauea, June 7, 1929, (NY); Forbes 934.H, In 1880-1 flow below Kipuka ahiu, June 24, 1915; Skottsberg 6781, Piihonua, on Puu Oo trail near crossroad, Apr. 7, 1948.

This species is a member of subgenus *Viginea* Beauv. (Kükenthal 1909:111), section *Elongatae* Kunth (Kükenthal 1909:226). This section presents a large number of species of worldwide distribution. The characters differentiating the species are so minor that the vast majority must be reduced to synonymy. Mackenzie lists a group of 19 species under section *Stellulatae* of Kunth.

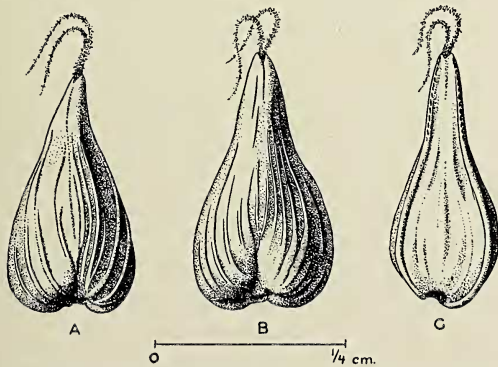


FIG. 6. Perigynia of *Carex Svenonis* Skottsberg. a, Forbes 934.H; b, Forbes 1181.M; c, Forbes 934.H (ventral side).

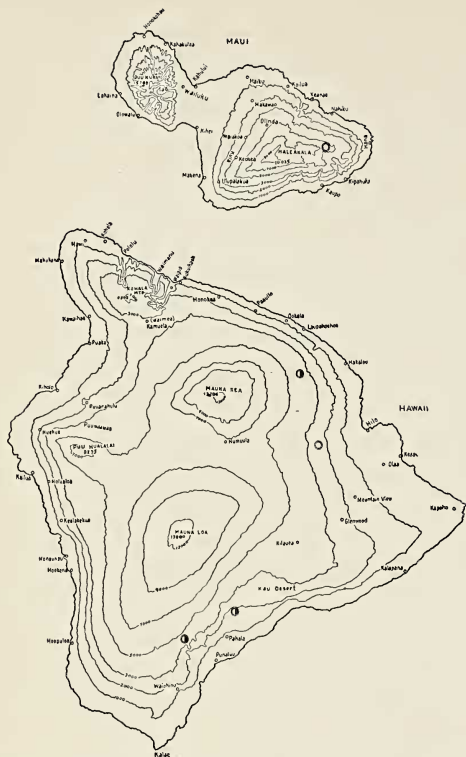


FIG. 7. Distribution of *Carex Svenonis* Skottsberg.

The characters used to differentiate these species—the shape of the teeth on the margins of the perigynia; intensity of nerving, width of leaf blades, etc.—are not reliable. Kükenthal has split the species *Carex stellulata* Good into 12 varieties and forms on characters little better than these but which conform to likely geographical distribution. It is felt that his more conservative treatment is more nearly the one to be accepted.

In his discussion of the new species *Svenonis*, Skottsberg (1944:330) writes at length concerning its status. He points out clearly the difficulties involved in placing the new plant in the midst of a confusion of closely related species which have not been critically monographed. His conclusion is, "It is possible that *Carex Svenonis* does not deserve the rank of a species, certainly not if *Carex echinata* (*stellulata*) is taken in the wider sense of Kükenthal. In any case it is

an addition to the Hawaiian flora." Skottsberg does not give enough evidence to delineate a new species from others in section *Stellulatae*. The only character that is of value is the occurrence on some culms of staminate terminal spikes, but this character is found in certain of the North American species (*Carex bromoides* Schkuhr.) and, according to Kükenthal, it also occurs in the species *stellulata* as well as in the section *Elongatae*. However, the species that are published must be critically revised for the world. No helpful decision can be reached for one species without a study of the entire sections *Stellulatae* Mack. and *Elongatae* Kunth. It seems unwise at this time to state that *Carex Svenonis* cannot be distinguished from any of many closely related species, when it is not even possible to determine those species from which it cannot be distinguished. *Carex Svenonis* and a large number of untenable segregates must be retained until that revision is made.

Carex Meyenii Nees, Nova Acta Acad. Leop., Carol. Nat. Cur. 19, Suppl. I, 1843.

Figs. 8a-c, 9

Carex Remyi Boeckeler, Flora 58: 269, 1875.

Carex brunnea Thunb. var. β Hillebd., Flora of the Hawaiian Islands 489, 1888.

Carex brunnea var. *Meyenii* Kükenth. Engler's Pflanzenreich IV, 20:601, 1901.

Rootstocks caespitose forming clumps to 40 cm. in diameter; basal scales 3–5 mm. wide, 0.5–1.5 mm. long, 5–10 per culm, ovate, multinerved, rich brown; fertile culm, 1–1.5 mm. wide, 30–60 cm. long, sharply triangular, smooth below, lightly scabrous above, pendent to semi-erect; leaves 2–3 mm. wide, 30–60 cm. long, 5–15 per culm, dark green; pendent narrow, lightly scabrous on main veins and margins, sheaths tight, closed by a hyaline, deeply notched membrane ex-

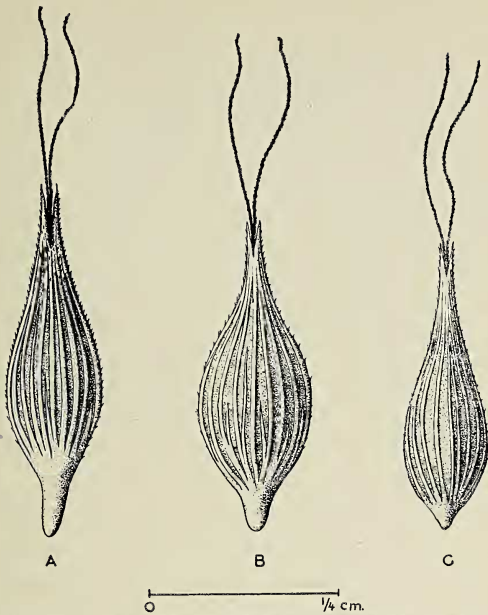


FIG. 8. Perigynia of *Carex Meyenii* Nees. *a*, *St. John & Catto* 17613; *b*, *St. John* 10382; *c*, *Rock* 8752.

tending 5–10 cm. above the rootstock, dark brown at the base; inflorescence 5–25 cm. long, pendent, 4–6 spikes arising from a node, 4–10 nodes per culm, each node subtended by a leafy bract 8–15 cm. long, lower internodes 2–4 cm. apart, upper internodes shortened, upper leafy bracts reduced to scales; spikes 2–3 mm. wide, 2–4 cm. long, androgynous, peduncles 1.5–3 cm. long, with membranous tubular cladophylla or ochreas 2–3 cm. long; pistillate bracts 1 mm. wide, 3 mm. long, hyaline, keeled, obscurely nerved; staminate bracts 0.8 mm. wide, 4 mm. long, lanceolate, keeled, hyaline-margined; perigynia 1–1.5 mm. wide, 3–4.5 mm. long, with body from ovoid to lanceoid, bi-convex to plano-convex, the base stipitate, greenish-brown to brown, chartaceous-membranous, strongly 9–12-nerved on a side, rostrum one fourth as long as the body, often minutely toothed on the upper third, bidentate, teeth 0.5–0.8 mm. long; achenes lenticular, minutely rugose in longitudinal lines, light brown to greenish; style and stigma

3 mm. long, stigmas two, 2 mm. long, minutely glandular, dark brown.

Distribution: On all islands in Zone D of Ripperton and Hosaka (1942), or middle forest between 600 feet and 3,500 feet on ridges in full sun or in dense shade and on moist rocky ravine walls. Optimum development in semi-shade.

Type: F. J. F. Meyen, in Oahu *Insula Sandvicensium*, June, 1831. The specimen is with the Meyen plants in the herbarium at Leningrad. Requests for the loan of plants from Leningrad were unanswered.

Specimens examined

KAUAI: *Faurie* 1201, Waimea, 1000 m., Mar. 1910, (KY); *Fosberg* 12673, head of Kalalau Valley, 1250 m., Dec. 29, 1935; *Mann & Brigham* 391, Waimea, 2000–3000', (C); *Nuttall*, Kauai (no data), (K); *Nuttall*, Kauai (no data), 1843, (K); *St. John* 22902, Kilauea Lookout, Kalalau Valley, 4000', Dec. 21, 1947.

OAHU: *Degener* 19412, N slope of Mt. Kaala, Feb. 2, 1949, (NY); *Faurie* 1209, Honolulu, Apr. 1909, (GB); *Faurie* 1211, Kaala, Nov. 1909, (KY); *Forbes* 2465.O, ridge between Niu and Wailupe, Apr. 11, 1917; *Forbes* 2525.O, Wailupe, Jan. 1919; *Fosberg* 10893, head of Makaha Valley, S side, 1500', Mar. 31, 1935, (US); *Fosberg* 13040, head of Kapuna Valley, Mokuleia, 600 m., Apr. 11, 1936; *Fosberg* 13602, head of Kawaihapai Gulch, Feb. 21, 1937; *Fosberg* 13005, E ridge of Puu Kalena, 950 m., Mar. 22, 1936; *Fosberg* 13631, N ridge of Puu Kumakalii, Mar. 28, 1937; *Gaudichaud*, near Honolulu and the Pali, 1836, (K); *Judd & Hosaka*, Pahaia Valley, sixth valley E of Makaliha, 1200', Dec. 2, 1931; *Krauss* 122, trail to Puu Kaua, 1800', Feb. 29, 1948; *Krauss* 119, trail to Puu Kaua, 1700', Feb. 29, 1948; *Krauss* 137, Papoli ridge above Maakua, 600', Mar. 21, 1948; *Krauss* 141, Papoli ridge above Maakua, 450', Mar. 21, 1948; *Krauss* 148, third ridge N of Palikea,



FIG. 9. Distribution of *Carex Meyenii* Nees.

W side, 2000', Mar. 26, 1948; *Krauss* 300, summit of Kuliouou Trail, Aug. 6, 1948; *Krauss* 299, below summit of Kuliouou Trail, Aug. 6, 1948; *Krauss* 298, below summit of Kuliouou Trail, Aug. 6, 1948; *Krauss* 291, Kuliouou Trail, 1200', Aug. 6, 1948; *Krauss* 290, Kuliouou Trail, 1200', Aug. 6, 1948; *Krauss* 317, Palolo Trail to Kaau Crater, 1400', Aug. 13, 1948; *Krauss* 557, Stream bed of Elehaha, 500' from Road, 850', Apr. 16, 1948; *Mann & Brigham* 260, Waialua Mts., (C); *Remy* 141, 1851-55, (GH, P); *St. John* 11026, Kipapa Gulch, second N fork, Waipio, 1300', Feb. 15, 1937; *St. John* 10382, N fork of valley E of Palikea, 1300', Feb. 23, 1930; *St. John* 13156, Pohakea Pass, 2200', May 12, 1933; *St. John* 14037, E ridge of Puu Kanehoa, 2400', Jan. 7, 1934; *Skottsberg* 44, Keawaawa, Aug. 4, 1922; *Wilkes Exped.*, Honolulu, 1838-42, (US).

MOLOKAI: *Faurie* 1207, Kamalo, June 1910, (KY); *Forbes* 361, Kaluaaha Valley, Aug. 1912.

LANAI: *Fagerlind & Skottsberg* 6767, summit of main ridge in wet forest, Apr. 2, 1948, (GB); *Fagerlind & Skottsberg* 6419,

NW part of main ridge, Feb. 25, 1948, (GB); *Fosberg* 12480, ridge below Puu Aalii between Maunalei drainage and Hauola drainage 2600', Nov. 30, 1935, (US); *Hitchcock* 14666, on largest mountain, Sept. 21, 1916, (US); *Munro* 155, ridge above Hookio, Oct. 11, 1913; *Munro* 451, Hookio, Oct. 6, 1913; *Rock* 8083, Mahana, July 25, 1910; *St. John* 18705, Puu Ealii, Kealia Apu-Kaunolu, 2700', Apr. 9, 1938.

MAUI: *Forbes* 320.M, Lahainaluna Valley, Feb. 19, 1913; *Forbes* 2391.M, Olowalu Valley, May 17, 1920; *Forbes* 2047.M, Kaulalii, middle Auwahi, Mar. 20, 1920; *Forbes* 2406.M, Olowalu Valley, May 17, 1920; *Forbes* 699.M, NE of Ukulele, July 9, 1919; *Hitchcock* 14961, Haleakala crater, 6000-10,000', Oct. 2-5, 1916, (US); *Hitchcock* 12900, Haleakala, 6000-10,000', Oct. 2-5, 1916; *Krauss* 464, confluence of Honokawai and Waikiki, Sept. 11, 1948; *Rock* 8752, Waikahu Valley, 900', May 1911; *St. John & Catto* 17613, S ridge of Launiupako Valley, 2550', Dec. 20, 1936.

HAWAII: *Skottsberg* 631, slope of Hualalai, 1200 m., Sept. 23, 1922.

Carex Meyenii Nees belongs to the subgenus *Eucarex*, Coss. & Germ., section *Hymenochlaenae*, Drejer (Kükenthal 1909: 576), subsection *Graciles*, Tuckerman (Kükenthal 1909: 599). The subsection is widespread in the Pacific from South America to the center of Asia. The Hawaiian plant has been described as *Carex Remyi* by Boeckeler, as *Carex Meyenii* by Nees, and, in part, as *Carex Commersoniana* by Kunth, all believing it to be a distinct species. *Carex Commersoniana* Kunth is described with "Sieb herb. Maurit. no. 50" cited as the type immediately following the binomial. However, after the description, *Carex Meyenii* of Nees is cited as a juvenile specimen of *Carex Commersoniana*. Kunth's description does not fit the Hawaiian plant, nor does Plate 155 of F. Boott in *Illustrations of the Genus Carex*, which was drawn from Mauritian material. There is no question that Kunth is naming the plant now known as *Carex brunnea* Thunb. under which Kükenthal cites Sieber herb. Maurit. no. 50. *Carex Commersoniana* Kunth is a later homonym of *Carex brunnea* Thunb. and cannot be applied to the Hawaiian species. Hillebrand (1888: 489) describes it as a new variety, β , of *Carex brunnea* based on Mann & Brigham 391. Kükenthal also describes it as a variety of *Carex brunnea*.

Authentic specimens of the Japanese *Carex brunnea* Thunb. were secured from the University of Kyoto, Japan. They are not the same species as the Hawaiian plant though they do clearly belong to the same subsection. The differences are pronounced. The perigynia in the Hawaiian plants are lanceolate with long tapering rostra. Those in the Japanese material (Faurie 4945) are broadly ovate to circular in outline with an abrupt narrow rostrum. Further, the surface of the perigynia in the Japanese material is strongly hispid with prominent white hairs. The Hawaiian perigynia have only setae on the margins. The bracts in the Japanese specimens

are broad ovate; those in the Hawaiian ones are much narrower.

The perigynia, in fact, more closely approach those in the Chinese *Carex longicruris* Nees. However, the long stigmas and the extreme branching spikes as well as the greater size in the latter make it a remote member of the subsection.

Carex Meyenii Nees is found on all the main islands but seems to have its center of distribution in the west, indicating a center of dispersion from either Kauai or Oahu.

Carex Nealae sp. nov.

Figs. 10a-c, 11

Rhizomatis distinctis lignosis caespitosis in apicibus, squamis radicibus 4-6 mm. latis 1-4 cm. longis 2-5 in culmis caducis, culmis 1.5-2 mm. latis 30-45 cm. longis erectis triangulis striatis glabris fuscis, laminis 4-5 mm. latis 15-50 cm. longis 3-10 in culmis saepe ad apicem compressis inflorescentiis excedendis marginibus superioribus scabris inferioribus glabris, vaginis membranis hyalinis clausis laminis culmibusque in fasciculo tenendis, inflorescentiis 3-4 mm. latis 4-6 cm. longis ramosis nodis 1-5 spiciferis 1-5 nodis, internodiis inferis 1-2 cm. longis supris brevioribus, nodis bractis laminiferis inclusis, spicis 3-4 mm. latis 1.5-5 cm. longis androgynis praeter terminalis masculis multifloribus, pedunculis 3-5 mm. longis includendis in ocreis bipartitis in apicibus purpurei-maculosis, squamis foeminis 1.4 mm. latis 2.5 mm. longis ovatis emarginatis cum costa alba interdum breve aristatis brevibus marginibus hyalinis rubris aut purpureis, squamis masculis 1.5 mm. latis 5 mm. longis lanceolatis emarginatis costa alba in marginibus rubris aut purpureis, utriculis 1.5-2 mm. latis 3-4 mm. longis ovoideis aut latis ovoideis stipitatis valde 5-6 nervosis fuscis cum glandibus rubris maculosis, rostris brevibus apicibus integribus, achenis obovoide biconvexis rugosis fuscis, stylis in duo stigmatibus glandulosis 2-3 mm. longis divisis.

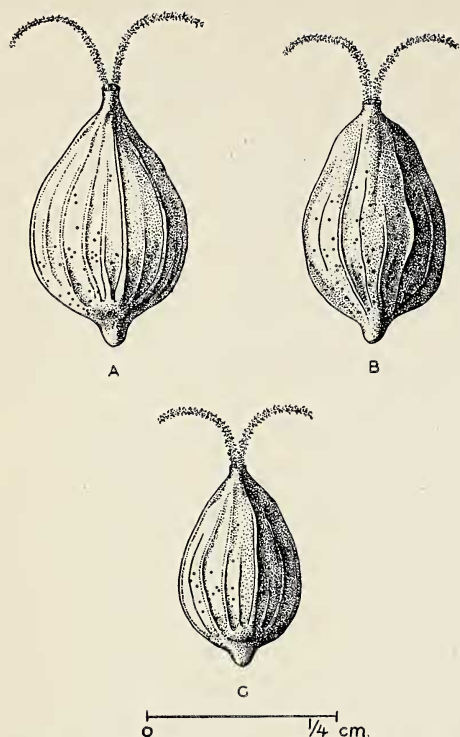


FIG. 10. Perigynia of *Carex Nealae* R. Krauss. a, Forbes 1187.M; b, Forbes 1191.M; c, Neal and Hartt 698.

Rhizome distinct, branching, lignescent, becoming caespitose at the apex; basal scales 4–6 mm. wide, 1–4 cm. long, brown, fibrillose, 2–5 per culm, caducous; fertile culm, 1.5–2 mm. wide, 30–45 cm. long, triangular in cross section, erect, stiff, striate, smooth on the angles, brown; leaves 4–5 mm. wide, 15–50 cm. long, slender, erect, 3–10 per culm, V-shaped, often folded to the apex, long, tapering, usually exceeding the inflorescence, sparsely scabrous on the upper margins, smooth below; sheaths closed by a hyaline membrane splitting almost at inception, holding culms and leaves in slender bundles 9–15 cm. above the base, dark brown; inflorescence 3–4 mm. wide, 4–6 cm. long, apical, erect, branching, one spike per node, 1–5 nodes per inflorescence, lower internodes 1–2 cm. long, the upper shorter, each node enclosed by a leafy bract, the lower 10–15 cm.

long, the upper shorter; spikes 3–4 mm. wide, 1.5–5 cm. long, androgynous except the terminal spike which is staminate, densely flowered, peduncles 3–5 mm. long, enclosed by a split ochrea 1–2 mm. long, purple-spotted at the apex; pistillate bracts 1.5 mm. wide, 2.5 mm. long, ovate, predominantly strongly emarginate with a single white dorsal nerve sometimes extending into a short awn, margins hyaline, red to purple; staminate bracts 1.5 mm. wide, 5 mm. long, lanceolate, emarginate, white along dorsal nerve, red to purple in margins; perigynia 1.5–2 mm. wide, 3–4 mm. long, ovoid or broadly so, bi-convex, short stipitate, strongly 5–6-nerved, brown, chartaceous, numerous spotted with reddish glands; rostrum tapering to an entire apex, achenes obovoid, bi-convex, more convex on one side than the other, minutely rugose, dark brown; style splitting into two spreading stigmas at the apex of the rostrum, stigmas 2–3 mm. long, glandular.

Distribution: Hawaii and Maui in Zones D and E of Ripperton and Hosaka (1942), the middle and upper forest, growing in bogs and pools in pahoehoe lava in full sun, rare.

Type: Forbes 1191.M, Waianapanapa, at edge of lake, Haleakala, Maui, Aug. 20, 1919.

Specimens examined

MAUI: Forbes 861.M, East of Ukulele, July 20, 1919; Forbes 1187.M, Waianapanapa, Haleakala, Aug. 20, 1919; Forbes 1191.M (See Type).

HAWAII: Neal M., and Hartt, C., 698, East of Humuula below Kalaechea in pool, 6200', Aug. 7, 1935.

Carex Nealae belongs in subgenus *Eucarex* Coss. & Germ., section *Acutae* Fries subsection *Vulgares* Aschens (Kükenthal 1909: 305). It has unquestioned Australian relationships, being close to *Carex Gaudichaudiana* Kunth, which grows in bogs in the mountains of New South Wales and New Zealand. It differs from this species, how-

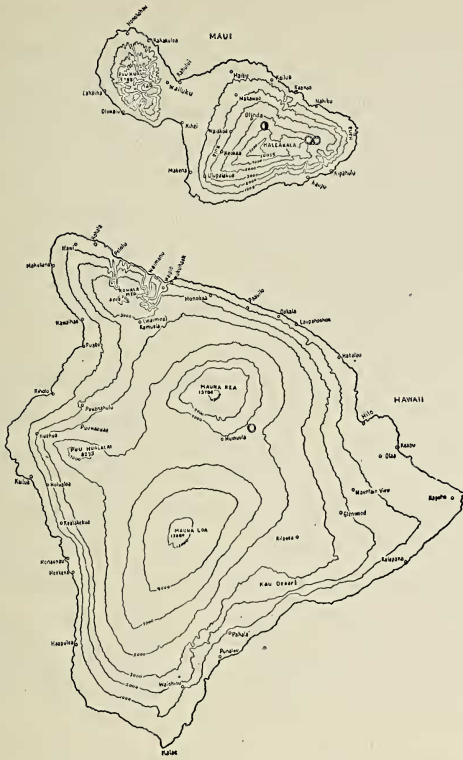


FIG. 11. Distribution of *Carex Nealae* R. Krauss.

ever, in several respects. In *Carex Nealae* the pistillate bracts are predominantly strongly emarginate and the margins are reddish-purple and opaque. In *Carex Gaudichaudiana* Kunth the pistillate bracts are all obtuse, and are light brown with hyaline margins. The spikes in *Carex Nealae* are 4–5 cm. long; those of *Carex Gaudichaudiana* Kunth are semi-globose, reaching only 2 cm. in length. The margins of the narrower leaves of *Carex Gaudichaudiana* Kunth are involute; those of *Carex Nealae* are not.

The species is named out of respect for Miss Marie Neal of the Bernice P. Bishop Museum Herbarium, who collected the plant on Hawaii in 1930.

The distribution of *Carex Nealae*, at present collected only four times, suggests that it is to be found at the edges of stagnant water at elevations over 3,000 feet. How-

ever, the vegetation need not be primarily bog type.

Carex macloviana D'Urv. (1826: 599) var. *subfusca* (W. Boott) Kükenth. Engler's Pflanzenreich, IV: 20, 197, Pl. V, 1909.

Figs. 12a–c, 13

Carex subfusca W. Boott. In: Botany of California 2:234, 1880.

Rootstocks caespitose, forming small clumps 15–20 cm. in diameter; basal scales two to four, 2–3 mm. wide, 1–5 cm. long, persistent, brown; fertile culm triangular in cross section, sides 0.6–1 mm. wide, 15–60 cm. long, strongly ribbed, scabrous on the angles, pendent, leaves 1–2 mm. wide, 10–70 cm. long, narrow, scabrous along midrib and margins, pendent, dark green; sheaths tightly closed by a chartaceous to hyaline membrane which splits almost at once to 10 cm. above the rootstock, brown; inflorescence forming ovoid to cylindrical head, 0.8–1 cm. wide, 1–2 cm. long, densely flowered, 4–9 spikes closely spirally arranged at the apex of the culm, internodes 1–2 mm. apart, each spike subtended by a bract, the lower leaf-like to 1 cm. long, the upper scale-like; spike gynaeandrous, 2–3 mm. wide, 5–6 mm. long, sessile, subtended by a leafy bract or scale which may have stipule-like appendages; pistillate bracts, 1.5–2 mm. wide, 3 mm. long, obovate acute to acuminate, with minute teeth on the keel near the apex, membranous, brown with a green keel; staminate bracts similar; perigynia 1.5–2 mm. wide, 3–4.5 mm. long, narrowly lanceoloid, long, tapering to the apex, narrowly winged, strongly concave-convex, faintly several-nerved on each side or not nerved, chartaceous, brown to green, wing toothed on the margins, rostrum grooved on the convex side, deeply bidentate on the convex side, shallowly bidentate on the concave side; achenes ovoid, bi-convex, stipitate, surface shining golden, minutely punctate; style 1.5–2 mm. long, splitting at half its length into two glandular stigmas.

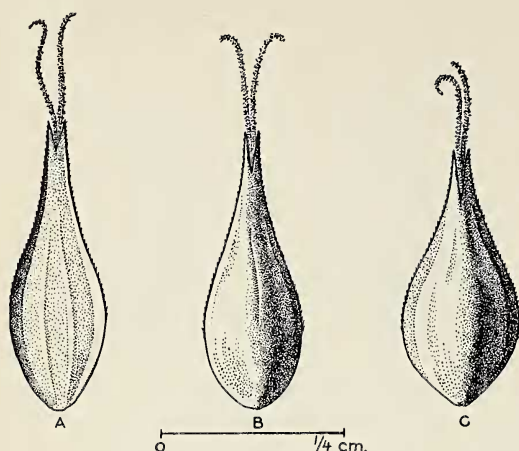


FIG. 12. Perigynia of *Carex macloviana* var. *subfusca* (W. Boott) Kükenth. *a*, *b*, Forbes 719.M; *c*, Giffard in 1911.

Distribution: Hawaii and Maui, in Zones D and E of Ripperton and Hosaka (1942), the upper forest, in dry, sunny meadows or grassy ravines, usually over 5,000 feet.

Type: Kellogg, Lake Tahoe, Bear Camp, Cal. (GH); from Herbarium of William Boott.

Specimens examined

MAUI: *Cranwell*, *Selling*, *Skottsberg* 2794, Haleakala, 2200 m., Aug. 4, 1938, (GB); *Degener*, Koolau Gap, June 29, 1929, (NY); *Degener* 9014, Mauka of Ulupalakua, July 4, 1927, (NY); *Degener* 9013, Slope of Haleakala, Aug. 10, 1927, (NY); *Degener* 9011, Pipe Line, Olinda, June 14, 1927, (NY); *Degener* 9015, Koolau Gap, Haleakala, Aug. 19, 1927, (NY); *Degener* 9012, Koolau Gap, Haleakala, June 29, 1927, (NY); *Faurie*, Haleakala Crater, Aug. 11, 1909; *Forbes* 1248.M, Kaupo Gap, Haleakala, Aug. 25, 1919; *Forbes* 719.M, E of Ukulele, July 11, 1919; *Forbes* 975a.M, Pasture above Ukulele, July 29, 1919; *Forbes* 1010.M, Kaanae Gap, Haleakaku, Aug. 2, 1919; *Forbes* 1099.M, Haleakala, Kaupo Gap, Aug. 9, 1919; *Forbes* 1186.M, N slope of Haleakala, Waianapanapa, Aug. 20, 1919; *Forbes* 1227.M, Bog below Waianapanapa, Aug.

25, 1919; *Hitchcock* 14977, Haleakala, 6–10,000', Oct. 2, 1916; *Krauss* 350, Switchback Trail above Holua, 8000', Sept. 3, 1948; *Krauss* 355, Draw behind Paliku, 6800', Sept. 2, 1948; *Krauss* 343, half mile N of Paliku, 7000', Sept. 3, 1948; *Krauss* 341, half mile N of Paliku, 7000', Sept. 3, 1948; *St. John* 17776, Haleakala Crater, Cinder Flat, 7000', Dec. 26, 1936; *Skottsberg* 830, Haleakala, inside crater, W side, 2200 m., Oct. 16, 1922.

HAWAII: *Degener* 9009, Kipuka Puaulu, Kilauea, May 1932, (NY); *Degener* 9010, Kau Desert, 10 M. from Volcano House, June 16, 1929, (NY); *Faurie* 1219, Mauna Kea, 2000 m., July 1909; *Faurie* 1220, Mauna Kea, 2000 m., July 1909; *Faurie* 1218, In Kilauea Volcano, May 1909; *Forbes*, Kona, Hanehane, June 15, 1911; *Forbes* 177.H, Hualalai above Hanehane, June 16, 1911; *Forbes* 306.H, Mauna Loa

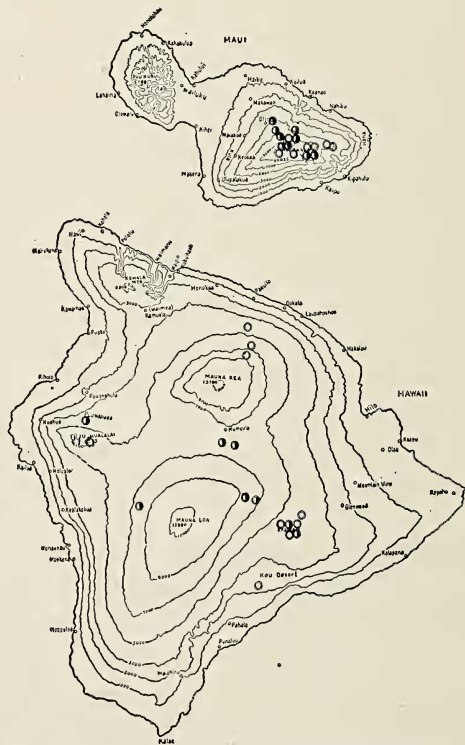


FIG. 13. Distribution of *Carex macloviana* var. *subfusca* (W. Boott) Kükenth.

below Pui-o-Uo, July 11, 1911; *Forbes* 972.H, Flow of 1823, Level of Keawewai, June 28, 1915; *Giffard*, Kilauea Volcano, June 1911; *Hapeman*, Volcano House, Kilauea, Apr. 23, 1908, (NY); *Hitchcock* 14528, Hualalai Mt., Sept. 2, 1916, (US); *Hitchcock* 14238, Kukaiau Ranch, 8000', Aug. 21, 1916, (US); *Hitchcock* 14226, Kukaiau Ranch, 3600', Aug. 20, 1916, (US); *Hitchcock* 14317, Maunakea, NE slope, 7000', Aug. 23, 1916, (US); *Mann & Brigham* 332, high central plateau of Hawaii; *Remy* 146, 1851-55, (GH); *Rock* 12731, Kilauea Volcano, July 1911; *St. John* 11438, Puu Hualalai, Kaupulehu, summit of volcanic cone, 8000', Dec. 30, 1931; *Skottsberg* 524b, E slope of Mauna Loa, Sept. 15, 1922, (GB); *Skottsberg* 570, Kilauea, Tree Fern Forest, Sept. 17, 1922, (GB); *Skottsberg* 494, Kilauea, crater trail, Sept. 12, 1922, (GB); *Skottsberg* 524, Trail to rest house, Mauna Loa, Sept. 15, 1922, (GB); *Wilkes Exped.*, 1838-42, (US).

Carex macloviana, in the subgenus *Vignea* (P. Beauv.) Nees (Kükenthal 1909: 111) section *Ovales* Kunth (Kükenthal 1909: 191), is a widespread and confusing species. Kükenthal has described 10 varieties and forms corresponding more to geographical regions than to characters. Specimens of a number of these varieties have been examined. They represent collections from California, Colorado, and Nevada in the United States, and from the Falkland Islands, Mexico, Greenland, Kamchatka, Canada, Unalaska, Sweden, and Chile.

The Hawaiian species show a clear relationship to the varieties *subfusca* (W. Boott) Kükenth. and *pachystachya* (Cham.) L. H. Bailey. They do not seem to be close to the varieties from South America which have perigynia which are more broadly winged, more strongly nerved, and less concave-convex in cross section. The latter include the type for *macloviana* sent from Santiago, Chile.

In my opinion many of the varieties of *Carex macloviana* D'Urv. represent differing biotypes with neither ecological nor genetic basis for their segregation. In specimens of the Hawaiian plant a clear gradation may be observed, often in the same inflorescence, from perigynia strongly nerved to not nerved, from strongly squarrose to not squarrose, etc.

The type collection of Kellogg from California has been examined. It corresponds very closely to the Hawaiian plant. It is not possible, without more material, to determine if *Carex subfusca* W. Boott is a good species. The world distribution of *Carex macloviana* D'Urv., and the slight differences in its population, prevent the retention of *Carex subfusca* W. Boott as a Linnaean species; however, its varietal status appears to be sound.

Carex pluvia sp. nov.

Figs. 14a-c, 15

Carex sandwicensis Boeckler (1875: 265)
var. *laxiflora* Kükenth. Fedde Rep. XVI,
435, 1920.

Rhizomatis caespitosis in glaebis laxis 30 cm. in diametro, squamis radiorum 7-8 mm. latis 1-5 cm. longis fibrillosis, culmis fertilibus 2-3 mm. latis 45-75 cm. longis erectis triangularibus concavis striatis glabris apicibus caulorum pendulis, 6-10 laminis 5-7 mm. latis 15-75 cm. longis pendulis culmis fertilis raro excedendis in marginibus saepe revolutis scabris in apice glabris in basi vaginis laxis membranace evanescentibus clausis, inflorescentis ramosis pendulis aut erectis 8-10 nodis unispiciferis pedunculis et ocreis in laminis-bracteis inclusis inflorescentiis excedendis, spicis 3-5 mm. latis 3-9 cm. longis multifructibus androgynis praeter spicis terminalis masculis, pedunculis in ocreis inclusis et squamis sterilis ocreis superioribus, squamis foeminis 1 mm. latis 4 mm. longis lanceolatis in centris triplinervis ovatis acuminatis marginibus hyalinis fulvis, squamis

masculis 0.5 mm. latis 4–5 mm. longis 2–3 nervosis, utriculis 1–1.5 mm. latis 2–4 mm. longis ellipsoideis aut ovoideis aut ovatis-ellipsoideis, chartaceis fulvis enervosis aut trinervis, breve stipitatis rostris bidentatis marginibus incrassatis raro setaciferis, achenis lenticularibus rugosis fulvis utriculis non complentibus, stylo 0.5–1 mm. longo erecti.

Rootstocks caespitose, forming loose clumps 30 cm. in diameter; basal scales 7–8 mm. wide, 1–5 cm. long, fibrillose; fertile culm 2–3 mm. wide, 45–75 cm. long, triangular in cross section, faces concave, erect, stiff, nodding only at the ends, striate, smooth; leaves 5–7 mm. wide, 15–75 cm. long, 6–10 per culm, pendent, slender, seldom exceeding the fertile culms, V-shaped in cross section, revolute at the margins, tapering, scabrous at the ends, smooth toward the base, light green; sheaths 3–8 cm. long, closed by a very thin rapidly disappearing membrane, loose, light brown; inflorescence pendent to semi-erect, branching, 8–10 nodes, one spike to a node, each node and ochrea bearing peduncle enclosed in a leafy bract exceeding the inflorescence by 1–10 cm.; spikes 3–5 mm. wide, 3–9 cm. long, androgynous except the terminal spike which is staminate, closely set with fruit, pedunculate, peduncles enclosed by an ochrea, several sterile scales above the ochrea; pistillate bracts 1 mm. wide, 4 mm. long, lanceolate to ovate, acuminate, triple-nerved in the center, green to yellow, margins hyaline, brown to red; staminate bracts lanceolate, 0.5 mm. wide, 4–5 mm. long, 2–3-nerved at the center; perigynia 1–1.5 mm. wide, 2–4 mm. long, ellipsoid, varying to ovoid or even obovoid-sub-spherical, chartaceous, yellow to brown, short stipitate, not nerved or with as many as three nerves, rostrum bidentate, margins ridged, occasionally armed with large, caducous setae; achenes lenticular, rugose, not filling the perigynia, yellow to brown; style erect, 0.5–1 mm. long, splitting into two glandular stigmas at the apex of the rostrum.

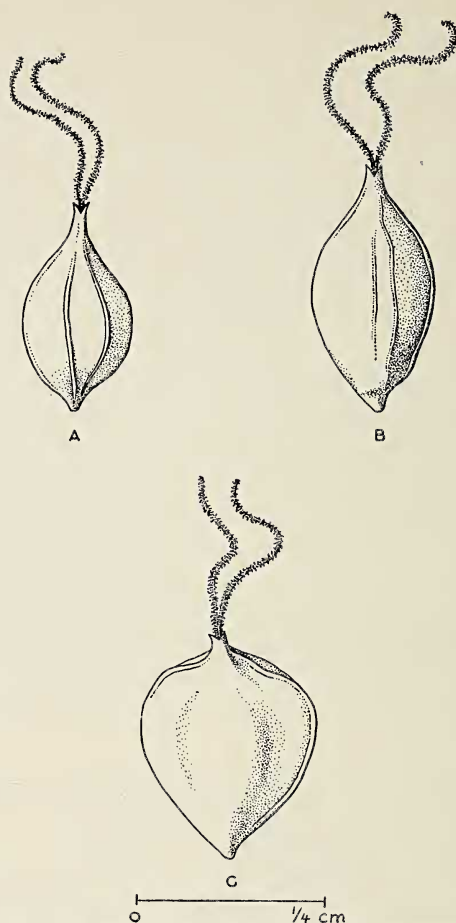


FIG. 14. Perigynia of *Carex pluvia* R. Krauss. a, Krauss 218; b, Fosberg 13757; c, Krauss 415.

Distribution: On all the islands, except Lanai, in Zone D₂ of Ripperton and Hosaka (1942), the middle forest, in very wet, shady places; often in the beds of streams or in the water.

Type: Krauss 218, In Kaluanui Stream among rocks beside rapidly flowing water, 1,950 feet, May 23, 1948.

Specimens examined

KAUAI: *Faurie* 1202, Waimea, 1000 m., Feb. 1910 (immature?); *Hitchcock* 15328, Kaholuamano, Mar. 3, 1901, (US); *Rock* 1665, Kaholuamano, Mar. 3, 1909; *Rock* 5042, Kaholuamano, Sept. 1909; *Smith*, *Whitney*, *Neal*, Kokee, 3500', May 1, 1929;

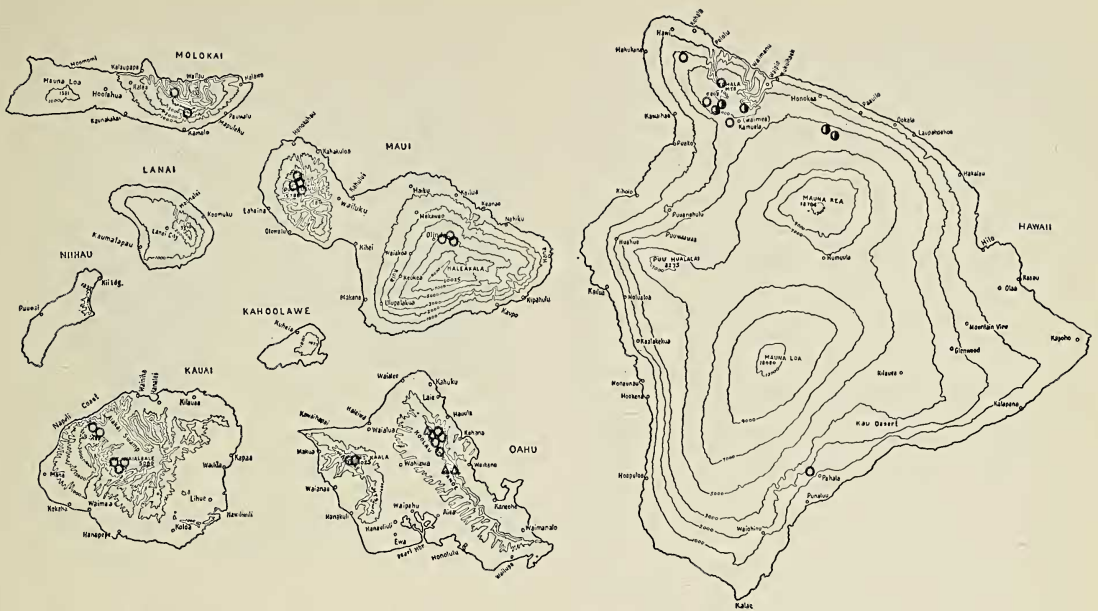


FIG. 15. Distribution of *Carex pluvia* R. Krauss (indicated by circles) and of *C. pluvia* var. *koolauensis* R. Krauss (indicated by triangles).

Wilder 450, Kokee Stream, 3600', Mar. 8, 1926.

OAHU: *Christophersen* 1747, top of Kaala, 1200 m., May 10, 1931; *Forbes & Clark*, between Punaluu and Kaipapau, May 3, 1909; *Fosberg* 13680, Puu Kaala summit, W side, Mar. 24, 1937; *Fosberg* 13757, Kaluanui Valley, 600 m., Apr. 25, 1937; *Krauss* 224, In Kaluanui Stream, 1950', May 23, 1948; *Krauss* 208, In Kaluanui Stream, 1950', May 23, 1948; *Krauss* 209, 210, 211, 212, 213, 214, 215, 216, 217, and 218 same data as 208; *Krauss* 505, in bed of Kaluanui stream, 1950', Nov. 21, 1948; *St. John & Cottam* 23556, Poamoho Stream, 2000', Feb. 20, 1949.

MOLOKAI: *Degener* 8236, S of Ohialele, May 8, 1928, (NY); *Hitchcock* 15094, North of Kamalo, 4000', Oct. 10, 1916, (US).

MAUI: *Degener* 8251a, Stream bed, Olinda Pipe Line, June 16, 1927, (NY); *Degener* 8248, Oohuola stream-bed near ditch trail, July 7, 1927, (NY); *Forbes* 1257.M, Kula Pipe Line, Waikamoi, Sept. 5-6, 1919;

Forbes 2602.M, Waikamoi Trail, June 25, 1920; *Forbes* 580.M, E of Ukulele, July 15, 1919; *Fosberg* 10040, Puu Kukui, pool, 1700 m., Aug. 24, 1933; *Hitchcock* 15094, N of Kamalo, 4000', Oct. 10, 1916, (US); *Krauss* 480, trail above Haelaau, Puu Kukui, 5000', Sept. 12, 1948; *Krauss* 380, Olinda Flume Line trail, 4300', Sept. 6, 1948; *Krauss* 473, trail above Haelaau, Puu Kukui, 5000', Sept. 12, 1948; *Krauss* 381, stream bed above Olinda trail, 4300', Sept. 6, 1948; *Krauss* 409, trail above Haelaau, Puu Kukui, 4800', Sept. 8, 1948; *Krauss* 415, trail above Haelaau, Puu Kukui, 4500', Sept. 8, 1948; *Krauss*, 427, trail above Haelaau, Puu Kukui, 4800', Sept. 8, 1948; *Rock* 8751, Olinda Waikamoi, Apr. 22, 1911.

HAWAII: *Cramwell* 3456, Kohala Mts. near Kamuela, Sept. 29, 1922, (GB); *Degener* 2216, 17 mi. from Kohala to Waimea, June 31, 1926, (NY); *Degener* 2212B, 17 mi. from Kohala to Waimea, June 31, 1926, (NY), (mixed collection); *Faurie* 1215, Glenwood, May 1907, (KY); *Forbes* 501.H, Kohala Mts., Waimea, Sept. 1911; *Rock*

3170, Paauhau, June 24, 1909; *Rock* 3173, Paauhau No. 1 Stream, 3000', June 24, 1909; *Skottsberg* 705, Kohala Mts. near Kamuela, Sept. 29, 1922, (GO); *Skottsberg* 593, S slope of Mauna Loa above Pahala, Sept. 19, 1922, (GO).

Carex pluvia R. Krauss, a member of subgenus *Eucarex*, section *Acutae* Fries, subsection *Cryptocarpae* Tuckerman (Kükenthal 1909: 297), stands close to *Carex alligata* F. Boott. It differs from the latter in the dull membranous to chartaceous bi-convex perigynia, which may bear setae on the rostrum and on the rostrum base, as in *Forbes* 501.H and *Forbes* 580.M. It is often 1-3-nerved from the stipitate base. This species is related to *Carex laciniata* F. Boott. It differs from *Carex laciniata* F. Boott primarily in the lack of the multiveined perigynia and in the more clearly bidentate rostrum; also, the peduncles are shorter and the internodes in the inflorescence are much reduced in *Carex pluvia*. It is usually of smaller stature, about 50 cm. long, rarely reaching 75 cm. Certain specimens have been collected with the intact spikes bearing hundreds of germinated seeds (*Krauss* 380).

The placing of the group as a species seemed at first to be questionable. Inasmuch as *Carex pluvia* and *Carex sandwicensis* were found growing together, especially on Maui, the possibility of wide biotypic variation seemed great. However, the plants growing in the same general areas seemed to have ecologic preferences, *Carex pluvia* in the wet shaded areas, often in running water, and *Carex alligata* in the drier sunny uplands. This suggested that they might be ecologic forms or varieties, but the distinctness of shape and surface of the perigynia, verified by repeated visits to the same plants as they matured, and the lack of intermediate forms between the two, although growing side by side, seem to eliminate this possibility. The distribution also gives some clue as to the constancy of the species. *Carex pluvia* is

found alone on Oahu and together with *Carex alligata* on Maui, Hawaii, and Kauai.

In spite of its distinguishing characters the species is probably a recent one. The differences within the specific limits, especially the occurrence of extremely large though caducous setae on the ridge running into the rostrum, are remarkable and would suggest another species to many taxonomists.

Carex laxiflora Lam is an earlier name applied to a different plant; therefore maintaining the epithet of the variety of Kükenthal would create a later homonym. The epithet *pluvia* suggests the habitat in and along watercourses subject to flooding. It is the Latin adjective *pluvius*, meaning wet or rainy.

Carex pluvia var. *koolauensis* var. nov.

Figs. 15, 16a-b

A specie differt in squamis radicum 8-12 mm. latis 1-11 cm. longis crassis persistentibus rubris aut purpureis culmis fertilibus 2-4 mm. latis, 50-100 cm. longis erectis striatis, in apicibus scabris ad basim glabris, laminis viridibus sed ad basim, rubris aut purpureis vaginis lignosis rubris aut purpureis, inflorescentis 8-15 cm. longis erectis ramosis 7-11 nodis 103 spiciferis, internodis inferis 2-3 cm. longis superioribus brevioribus, bractis-laminiferis inferioribus 30-45 cm. longis superioribus brevioribus, pedunculis 3-7 mm. longis in ocreis purpureis lanceolatis inclusis, squamis foeminis utriculis aequantibus carinis dorsalibus 2-3 albi-nervosis in marginibus membranaecis purpureis, utriculis 1-2 mm. latis 3-4 mm. longis incrassatis striatis ovoideis aut anguste oblongi-ovoides purpureis-nigris fulgentibus stipitatis rostris 1 mm. longis bidentis, achaenis biconvexis obovoideis utriculis semi-complentibus rugosis aut glabris aureis.

Differs from the species in the following characters: basal scales 8-12 mm. wide, 1-11 cm. long, coarse, persistent, shiny, red to

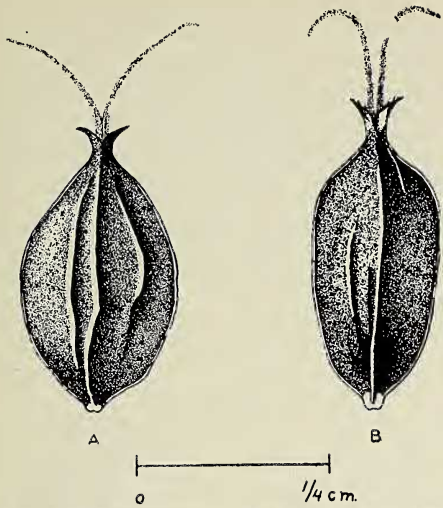


FIG. 16. Perigynia of *Carex pluvia* R. Krauss var. *koolauensis* R. Krauss. a, Hosaka 594; b, St. John 17978.

purple; fertile culm 2–4 mm. wide, 50–100 cm. long, erect, striate, scabrous on the angles above, smooth below; leaves brilliant red to purple at the base, light green above; sheaths ligneous, brilliant red to purple; inflorescence 8–15 cm. long, erect, branching, 1–3 spikes to a node, 7–11 nodes to an inflorescence, the lower 2–3 internodes 2–3 cm. long, the upper much shorter forming a dense head, each node enclosed by a leafy bract, the lower 30–45 cm. long, the upper shorter; peduncles of spikes 3–7 mm. long, enclosed by a purple, lanceolate ochrea; pistillate bracts equalling the perigynia, 2–3 white nerves along the dorsal keel, margins membranous, purple; staminate bracts lanceolate, 2–3 white nerves along the keel, margins membranous, purple; perigynia 1–2 mm. wide, 3–4 mm long, ridged, ovoid or narrowly oblong-obovoid, 1–3 ridged or veined, shiny, purple to black, rostrum 1 mm. long, bidentate, stipitate; achenes bi-convex, obovoid, filling only half of the perigynium, rugose to smooth, yellow.

Distribution: Oahu in Zone D₂ of Riperton and Hosaka (1942), the middle forest, in wet areas in turf; usually with grasses.

Type: Hosaka 594, Kipapa Gulch, 2,500 feet, July 4, 1932.

Specimens examined

OAHU: Fosberg 9730, Kipapa Gulch, 850 m., Aug. 6, 1933; Fosberg and Hosaka 13946, head of Kawaiiki Gulch and Kaluanui Gulch, 900 m., May 30, 1937; Hosaka 594 (see type); St. John 17978, Hauula, Castle Trail, 2500', Apr. 25, 1937; Takata, Castle Trail, Kaluanui, 1000', Apr. 25, 1937.

The variety *koolauensis* was first found by Edward Hosaka in 1932. It has been collected since in two other stations on Oahu. The variety shows transition with the species in Fosberg and Hosaka 13946 in that the purple-black covering of the perigynia is fully formed in some and just beginning to form in others. The perigynia are characteristically more narrow and more strongly stipitate than those of the species. The two teeth of the beak are longer and more conspicuously divaricate. With the small number of collections it seems unwise to classify the population as a new species, though its appearance is considerably different. Its rarity, in turf in regions well populated by the species, suggests the possibility that it is a variation resulting from an unusual combination of minor genetic differences as well as of ecological extremes.

Carex alligata F. Boott, *Illust. Genus Carex* IV, 129, 1867.

Figs. 17a–f, 18

Carex sandwicensis Boeckler, *Flora*, 265, 1875.

Carex crustacea Nelves, *Kew Bull.* I, 11, 1946.

Rootstocks caespitose; basal scales 8–15 mm. wide, 3–12 cm. long, 3–6 per culm, fibrillose, brown to purple; fertile culm triangular in cross section, 3–4 mm. wide, 60–150 cm. long, erect, striate, scabrous on the angles above, becoming smooth below; leaves 8–15 mm. wide, 20–120 cm. long, 4–8 per fertile culm, erect below, pendent above, V-shaped to flat, shiny, scabrous on the main

veins and margins, tapering, dark green; sheaths 25 cm. long, tight, closed by a brown to red membrane; inflorescence 10–15 cm. long, branching, pendent, 4–6 nodes, one spike per node, internodes 2–3 cm. long at the base shortening toward the apex, each node and peduncle enclosed by a leafy bract 1–30 cm. long, the lowest bracts being the longest; spikes androgynous except the terminal one which is staminate, 3–5 mm. wide, 5–10 cm. long, densely set with fruit, 7–8 ranks of perigynia around the axis; pistillate bracts oblong to obovate, 1.5–2 mm. wide, 3–4 mm. long, short-awned, three green to yellow nerves at the center, margins hyaline, brown to purple; staminate bracts lanceolate, 1 mm. wide, 4–5 mm. long, three center nerves yellow to brown, margins brown to purple; perigynia subspherical-ovoid or even ellipsoid, 2 mm. wide, 2.5 mm. long, lenticular, bi-convex in cross section with a distinct bulge giving one face more convexity than the other, two distinct ridges along the margins from the rostrum to the base, often a third along the bulge, rostrum shallowly bi-dentate, 5 mm. long, highly polished, smooth, obscurely nerved when immature, light brown to very dark brown; achenes obovoid, lenticular, glabrous to sparsely hirsute, minutely rugose, not filling the perigynium, yellow to brown; style 2–3 mm. long, doubled back against the achene and then passing out of the rostrum, splitting into two stigmas at the apex of the beak, glandular.

Distribution: Hawaii, Maui, Molokai, and Kauai in Zones D and E of Ripperton and Hosaka (1942), the middle and upper forest, in open places in the forest, along ditches and roadsides; common.

Type: U. S. South Pacific Exploring Expedition under the command of Capt. Wilkes, U. S. N., 1838–42, Sandwich Islands, Hawaii, U. S. National Herb. No. 27224.

Specimens examined

KAUAI: *Degener* 2208, Waianeke Swamp,

June 28, 1926, (NY); *Degener* 2210, Kokee Camp, June 25, 1926, (NY); *Fosberg* 12674, Plateau at the head of Kalalau Valley, 1250 m., Dec. 29, 1935; *Fosberg* 12675, Plateau at the head of Kalalau Valley, 1250 m., Dec. 29, 1935.

MOLOKAI: *Remy* 148, 1851–55, (GH); *Forbes* 438.Mo, Kolapamoa, Aug. 1912.

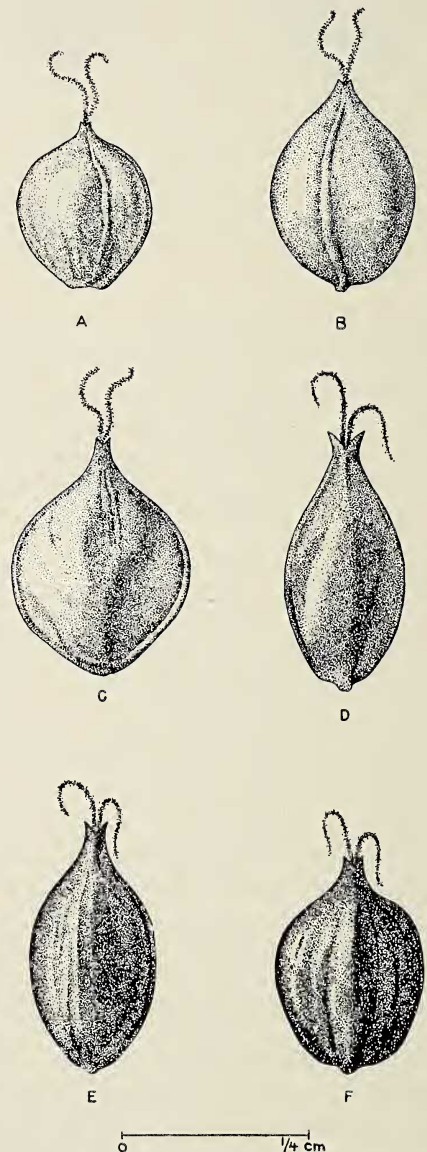


FIG. 17. Perigynia of *Carex alligata* F. Boott. a, *Degener* 8251; b, *Degener* 2213; c, *Krauss* 481; d, *Krauss* 477; e and f, *Fosberg* 12675.

MAUI: *Degener* 8261, Koolau Gap within Haleakala Crater, Aug. 17, 1928, (NY); *Degener* 8256, Olinda Pipe Line Trail, June 14, 1927, (NY); *Degener* 8240, Olinda Pipe Line Trail, July 30, 1927, (NY); *Degener* 8251*b*, Olinda Pipe Line, June 16, 1927, (NY); *Forbes* 692.M, Ukulele, July 1919; *Forbes* 857*a*.M, E of Ukulele, July 20, 1919; *Forbes* 907.M, Ukulele, July 1919; *Forbes* 1168.M, N slope of Haleakala, Aug. 17, 1919; *Hitchcock* 14757, Puu Kukui, Sept. 24–26, 1916, (US); *Hitchcock* 14926, E of Olinda, 4000', Oct. 1, 1916, (US); *Krauss* 338, 339, 340, 353, Draw behind Paliku, 6500', Sept. 3, 1948; *Krauss* 386, Olinda Dam end of Flume Line, 4400', Sept. 6, 1948; *Krauss* 388, Olinda Flume Line, 4300', Sept. 6, 1948; *Krauss* 389, road to Olinda Dam, 4400', Sept. 6, 1948; *Krauss* 395, Olinda Flume Line, 4300', Sept. 6, 1948; *Krauss* 432, trail above Haelaau, Puu Kukui, 3500', Sept. 12, 1948; *Krauss* 477, trail above Haelaau, Puu Kukui, 3700', Sept. 12, 1948; *Krauss* 481, trail above Haelaau, Puu Kukui, 4000', Sept. 12, 1948; *Rock* 8759, Waikamoi Trail, May 14, 1911; *Rock* 8761, Waikamoi Trail, May 14, 1911; *St. John* 10307, Kula, Olinda Pipe Line, 4400', Feb. 11, 1930.

HAWAII: *Degener* 2212*A*, 17 Mi. from Kohala toward Waimea, Aug. 1, 1926, (NY), (mixed collection); *Degener* 2213, 17 mi. trail from Kohala to Waimea, Aug. 14, 1926, (NY); *Degener* 19411, Popalooa, June 7, 1948, (NY); *Faurie* 1221, Mauna Kea, 2000 m., July 1909, (KY); *Faurie* 1280, Halawa, 800 m., June 1909, (KY); *Forbes* 389.H, Kau Desert, Aug. 2, 1911; *Forbes* 803.H, Hale Oloha, June 10, 1915; *Hillebrand* 534, (K); *Hitchcock* 14378, Waimea, Aug. 26, 1916, (US); *Mann & Brigham* 325, high central plateau, 1867, (G, US); *Remy*, (K); *Skottsberg* 593, forest above Pahala, 1000 m., Sept. 19, 1922, (GB); *St. John & R. S. Cowan & D. P. Rodgers* 22400, Saddle Road, Waiakea, S Hilo, 4000',

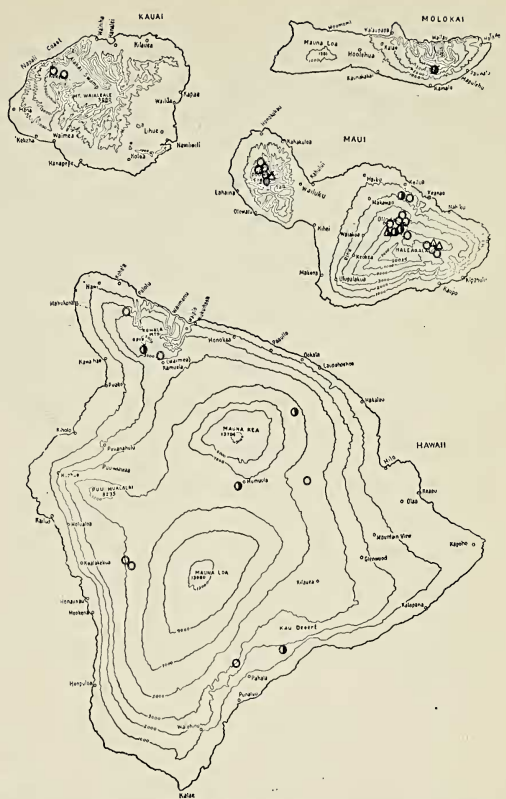


FIG. 18. Distribution of *Carex alligata* F. Boott (indicated by circles) and of *C. alligata* var. *Degeneri* R. Krauss (indicated by triangles).

Dec. 26, 1946; *Wilkes Exped.*, 1838–42, (US); *Wilkes Exped.*, forest above sawmill, (K).

Carex alligata Boott is a member of subgenus *Eucarex*, Coss. and Germ., section *Acutae* Fries, and subsection *Cryptocarpae* Tuckerman. It stands by itself within the group. Relationship of this species with the other *Cryptocarpae* in the islands is close but the characters separating them are clear. (See *Carex kauaiensis*, *Carex pluvia*, and *Carex pluvia* var. *koolauensis*.) The species seems to be an old one in the islands and the stock from which it sprang probably gave rise to the other two species and varieties. As mentioned before this group is a variable one and may be confusing. The young perigynia are a light yellow which sometimes turns to a very dark brown. This transition may be ob-

served by placing the perigynia in a moist petri dish for a few days. This variation in color may occur as in *Fosberg 12675* and *12674*, where all gradations may be seen on a single spike, or it may be found without intermediates, the perigynia being not only black or turning black but somewhat oval with exaggerated rostra, as in *Krauss 476, 479, 478*. The species responds with unusual sensitivity to the environment and may develop some of its different forms as a result of recombinations of one or more slightly different mutant genes affecting shape and surface of the perigynia.

Carex sandwicensis Boeck. based on *Remy 148*, Molokai, 1851-55 (G), is a later synonym published in 1875 and made by Boeckler apparently without knowledge of the earlier publication of Boott in 1867. It has been accepted and used widely but must be submerged.

Carex crustacea Nelmes, represented only by the type, is rather unusual in the great length of the internodes between the spikes and also in the reduced size of the spikes. The more normal internodes are 2-3 cm. long at the base and seldom as long above, as in Nelmes' *Carex crustacea*. It is believed from a study of the population that *Carex crustacea* cannot be maintained as a species. It is regrettable that at this stage in our science a species should be described from one fragmentary specimen and in a few vague words as a footnote to a key.

Carex Prescottiana Boott is illustrated in Boott's *Illustrations of the Genus Carex* from a collection of the U. S. Exploring Expedition (the Wilkes Expedition) from "the forest above the sawmill, Hawaii." The specimen secured from Kew has a note as follows:

Laid in from herb. Boott, Oct. 1894. This is the whole Sandwich material which Boott subsequently pasted down in his type cover of *Carex Prescottiana*. From California Boott founded his *Carex Pres-*

cottiana on Wall. Col. 3386 and published it in Proc. Linn. Soc., v. I, p. 280. When he got this material from Hawaii he determined it as identical with Wallich n. 3386 and then marked a query against Wallich's locality Nepal. I consider that the Hawaiian plant differs specifically from the Nepal one. It is *Carex sandwicensis*, Boeck.

C. B. Clarke, Oct. 1894

All that remains of this specimen is a packet of one dozen loose fruits. On examination the black spots illustrated in Boott (1867: 45, Pl. 115) prove to be spots of a fungal infection. The veins shown in Boott's illustration are not found in all perigynia and in none as strongly as drawn. The two teeth of the rostrum are distinct in most of the fruits though the infected ones seem to be broken or missing. Clarke's conclusion is valid. The remaining specimens, however, do suggest a gradation into variety *Degeneri* which is found on Maui and Hawaii.

The type material which is figured by Boott is mentioned only as coming from the Wilkes Expedition collections in the district of Waimea, Hawaii. The material from the Wilkes Expedition marked *Carex alligata* Boott is now in the U. S. National Herbarium and is the only specimen which fits Boott's plate. The specimen, although it is the type, is not typical. It is a small young plant with somewhat narrower perigynia than those commonly found. Moreover, the perigynia have become dark although the typical surface persists.

Carex alligata Boott var. *Degeneri* var. nov.

Figs. 18, 19a-b

A specie differt in squamis foeminis purpureis aut purpureis-nigris in marginibus glabris aut albo-fimbriati carinis albis centralibus saepe aristatis, utriculis 1-2 mm. longis 2-5 mm. latis ovalibus aut ellipsoideis in lineamenta tenuiter biconvexis incorporis fulvis

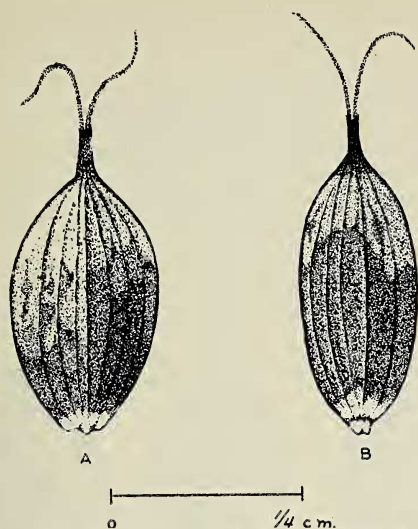


FIG. 19. Perigynia of *Carex alligata* F. Boott var. *Degeneri* R. Krauss. a, b, *Degener* 8253.

purpurei-maculosis, nervosis 5–8 gracilibus basis ad apicos extendentibus breve stipitatis apicibus rostrorum integris aut breve bidentatis oribus glabris aut setaciferis.

Vegetatively showing the same characters as the species but different in the following: pistillate bracts purple-black to black, smooth or white fringed on the margins, white-keeled through the center, prolonged in some to a setaceous awn; perigynia 1–2 mm. long, 3–5 mm. wide, narrow, oval to elliptic in outline, thinly bi-convex, surface yellow-brown spotted with purple, short stipitate, rostrum with an entire or weakly bidentate apex smooth or setaceous at the mouth, 5–8 thin nerves extending from base to the apex.

Type: *Forbes* 1189.M, Bog at Waianapanapa, Maui, Aug. 23, 1919.

Specimens examined

MAUI: *Degener* 8253, Mauka of Olinda on the way to Haleakala, June 15, 1927; *Forbes* 1189.M, Bog at Waianapanapa, Aug. 23, 1919; *Forbes* 1226.M, Waianapanapa, Aug. 23, 1919; *Fosberg* 10026, between Nalakalua and summit of Puu Kukui, 1740 m., Aug. 24, 1933.

This variety has a distinctly veined surface

of the perigynium and an entire or slightly bidentate rostrum. There is a suggestion of the characteristic structure of the variety in certain other of the Maui specimens, especially those collected near Paliku, Maui, indicating a degree of transition. Individual plants give the impression of different species but the presence of intergradations makes a higher category impossible.

Carex kauaiensis sp. nov.

Figs. 20a–c, 21

Carex sandwicensis Boeck. f. *subverticillata* Kükenth. Fedde Rep. XVI, 435, 1920.

Rhizomatis caespitosis, squamis radibus 8–10 mm. latis 2.5–11 cm. longis rubri-aut fuscilineatis culmis fertilibus triangularibus 2.4–4 mm. latis 120–150 cm. longis infra glabris supra scabris erectis, 4–8 laminis 13 mm. latis 150–200 cm. longis erectis in apicibus pendulis crassis in basis glabris in venosis et marginibus superioribus scabris, vaginis membranacis strictis 25 cm. altis deinde partitis inflorescentibus 15–20 cm. longis 5–8 mm. latis ramosis 6–7 nodis unispiciferis internodi inferioribus 2–3 cm. longis superioribus brevioribus bracteis laminiferis 2–4 mm. latis 3–30 cm. longis nodis inclusis, spicis androgynis praeter terminalis masculis 2–4 mm. latis 8–15 cm. longis pendulis laxe fructiferis utriculis vix basis utriculis superioribus contigendis, pedunculis 1–3 cm. longis ocreis 5–8 mm. longis striatis fissuratis inclusis, utriculis 3.5–6.5 mm. longis 1.5–2 mm. latis ellipsoideis aut obovoideis in rostro breve abrupte, coartato basi lata obtusa aut emarginata purpureis-nigris lucidibus scrobiculatis, costis tres ex rostris descendentibus ad basim et obscurantibus, achaenis obovoideis aureis rugosis triangularibus una latere latiora, stylis in 2 stigmatibus 1 mm. supris rostris divisis.

Rootstocks caespitose; basal scales 8–10 mm. wide, 2.5–11 cm. long, streaked red or brown; fertile culm triangular in cross section,

2.4–4 mm. wide, 120–150 cm. long, stiff, erect, smooth on the lower angles, lightly scabrous above; leaves 13 mm. wide, 150–200 cm. long, 4–8 per culm, erect, pendent at the ends, coarse, dark green, smooth at the base, becoming scabrous along the edges and main vein toward the apex; sheaths closed by a striate membrane to 25 cm. above the base, splitting at maturity, tight, holding the base as a slender unit; inflorescence branching, 15–20 cm. long, 5–8 mm. wide, 6–7 nodes per culm, one spike to a node, internodes 2–3 cm. at the base, shortening to 1 cm. at the apex, each node subtended by a leafy bract 2–4 mm. wide, 3–30 cm. long; spikes androgynous except the terminal one which is staminate, 2–4 mm. wide, 8–15 cm. long, pendent, sparsely set with fruit, the apex of one perigynium scarcely reaching the base of the next above it, peduncles 1–3 cm. long, enclosed by a striate, purple, split ochrea 5–8 mm. long; pistillate bract 1.5–2 mm. wide, 4–5 mm. long, ovate, short-awned, awn and three central veins white to yellow, membranous wings of the bract black to purple-black, waxy, awn 1–2 mm. long, toothed, broad; staminate bracts 1 mm. wide, 6–8 mm. long, lanceolate, short-awned, the awn toothed; perigynia 1.5–2 mm. wide, 3.5–6.5 mm. long, ellipsoid or broadly ellipsoid to obovoid, abruptly narrowed to the short 3–5 mm. bidentate rostrum, the base broad-obtuse or even emarginate, highly polished, black, finely scrobiculate surface with three obscure ridge lines equally radiating from the rostrum disappearing toward the base, triangular in cross section; achenes obovoid, yellow, minutely rugose, triangular in cross section, one side broader than the other two; style splitting into two stigmas 1 mm. above the rostrum, stigmas 1–2 mm. long, glandular, black.

Distribution: Kauai only, high bogs in Zones C₂ and D of Ripperton and Hosaka (1942), over 3,000 feet, in extremely wet open forest areas.

Type: Rock 9017, Kauluwehi Swamp, 4200', Oct. 1909.

Specimens examined

KAUAI: *Degener* 2208, Waiveke Swamp, Kokee, June 28, 1926, (NY); *Forbes* 419.K, Kaholuamano Swamp, Sept. 1909; *Forbes*

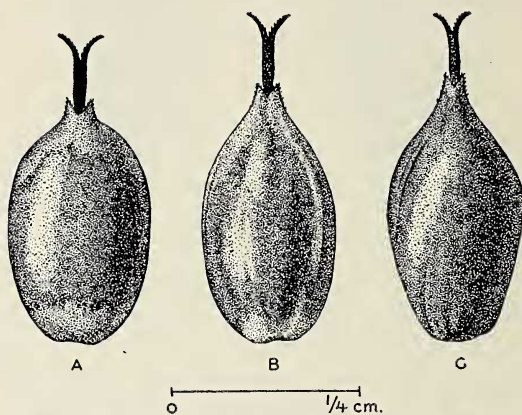


FIG. 20. Perigynia of *Carex kauaiensis* R. Krauss. a, Rock 9017; b, *Forbes* 419.K; c, *Skottsberg* 902.

885.K, Alakai Swamp, Waimea Drainage Basin, West Side, July 3–Aug. 18, 1917; *Forbes* 883.K, Waimea Drainage Basin, West Side, Alakai Swamp; *Rock* 9017, Kauluwehi Swamp, 4200', Oct. 1909; *Skottsberg* 902, forest near Alakai Swamp, Oct. 27, 1922, (GO); *St. John* 23047, Alakai Trail at BM 3698 3700', Dec. 25, 1947; *St. John* 23040, Alakai Trail NE of second fork of Kawaikoi Stream, Dec. 25, 1947; *St. John* 23041, Alakai Trail 3900', Dec. 25, 1947; *St. John* 22926, Ridge SW of Pihea, 4000', Dec. 22, 1947.

Carex kauaiensis is a member of the subgenus *Eucarex*, section *Acutae*, subsection *Cryptocarpae*. It appears to be a recent species evolved from the line leading to *Carex alligata*. It differs from this in the pronounced smooth, polished, non-stipitate perigynium, the long-awned bracts, and the triangular achene as well as the long internodes between points of perigynial attachment on the rachis.

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